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The Epidemiology of Streptococcal Infections.

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I.—Dr. V. D. Allison.

The genus *Streptococcus* in relation to human disease may be divided into three species, as described by Smith and Brown [1], and Brown [2], according to their action on blood-agar plates: (*a*) *Str. hæmolyticus* giving β-hæmolysis or true hæmolysis, (*b*) *Str. viridans* showing α-hæmolysis or green coloration, and (*c*) *Str. fæcalis*, the γ-type having no action on blood. This classification enables us to limit the scope of our subject to the first species, *Str. hæmolyticus*, whose epidemiological importance is accepted. *Str. viridans* has not hitherto been found to form any soluble toxin; it is recognized as the cause of most cases of subacute bacterial endocarditis in man, and is suspect of being ætiologically connected with various forms of rheumatism, by absorption from the teeth, tonsils, gut, or other focus of infection. The causal relationship between the green-producing streptococcus, described by Tunnicliff [3, 4], and measles, has not been confirmed. *Str. fæcalis* also produces no exotoxin and is as a rule non-pathogenic, although it may, under exceptional circumstances, assume a pathogenic rôle.

THE SEROLOGICAL CLASSIFICATION AND DISTRIBUTION OF SCARLATINAL STREPTOCOCCI.

It is well known that there are serious technical difficulties associated with the classification of hæmolytic streptococci by serological methods. Much patience and modification of technique, as occasion demands, are necessary in order to obtain results and overcome inconsistencies. This is in large part due to the great tendency of the organisms to form granular growths in fluid media, and to agglutinate spontaneously in saline, and also to the fact that many strains may show antigenic variations, leading to contradictory findings.

The typing of scarlatinal streptococci.—From the mass of conflicting claims of the specificity of the agglutinative reactions of hæmolytic streptococci from various infections, we have concentrated on the work of Smith [5] and Griffith [6, 7], who described a serological classification of hæmolytic streptococci, obtained from cases of scarlet fever. Griffith described four main serological types of scarlatinal streptococci, constantly associated with cases of scarlet fever, and during the past five years I have used his methods and technique, with slight modifications, in the study with my colleague, Dr. W. Gunn, of hæmolytic streptococci from scarlet fever and other infections due to, or associated with, these organisms. The value of this method of investigating hæmolytic streptococci from scarlet fever is seen in the following instances:—

(1) The ready identification of the great majority of strains as scarlatinal.
(2) The identification of the same type (*a*) as the infecting agent when scarlet fever occurs in more than one member of the same family, (*b*) as the cause of an outbreak in a diphtheria or measles ward, or (*c*) as an epidemic in a public school as shown recently by Glover and Griffith [8].
(3) The correlation between infecting type and the clinical severity of the disease.
(4) The prevalence of a particular type, indicating the mildness or severity of an epidemic.
(5) The relation between strains found in secondary attacks to those isolated during the primary infection.
(6) The quantitative and qualitative study of the toxigenic properties of different types.

TABLE I.—THE DISTRIBUTION OF SCARLATINAL TYPES OF STREPTOCOCCI IN 700 CASES OF SCARLET FEVER, 1926-1931.

Year	No. of cases	Percentage of types				
		Type 1	Type 2	Type 3	Type 4	HET	Negative
1926	*100	2	34	17	23	17	7
1927	*100	8	14	26	12	31	9
1928	200	9	25	17	5	36	8
1929	100	18	20	22	3	36	1
1930	100	17	19	19	7	35	3
1931	100	20	16	17	10	34	3
1926-31	700	11·9	21·9	19·3	9·3	32·1	5·5

Types 1, 2, 3, 4 ... ... 62·4%
HET = Heterogeneous type ... ... 32·1%
NEG = Negative on first examination 5·5%

*Investigated by Gunn and Griffith.

The distribution of types in scarlet fever.—Table I shows the distribution of scarlatinal types of streptococci from 700 cases of scarlet fever over a period of six years. It will be seen that during this period the relative distribution of types has not varied greatly; there is a lower incidence of Type 4 strains and an increase in the incidence of Type 1 strains, while the proportion of unclassified strains has remained remarkably constant.

TABLE II.—THE SEROLOGICAL GROUPING OF 26 STRAINS OF SCARLATINAL STREPTOCOCCI.

(*From Prof. U. Friedmann, Berlin.*)

Type	Number of strains	Percentage of strains
1	8	30·8
2	—	—
3	12	46·1
4	4	15·4
Heterogeneous	2	7·7
Total	26	100

I am indebted to Professor Ulrich Friedemann, Berlin, for twenty-six strains of scarlatinal streptococci which, when typed, gave the results shown in Table II. This is noteworthy for the absence of any representatives of Type 2. Using Griffith's four type sera, Williams, and others [9], in New York City, examined a large number of strains of scarlatinal streptococci, and found that the majority could be classified, but they also failed to find a representative of Type 2 in their series. I have personally examined a number of other isolated strains from America, Germany, and Jugoslavia, and although many of them could be classified, I have been unable to assign any to the Type 2 group, which appears to be peculiar to this country.

The occurrence of primary and secondary infecting types and their significance.—In observations carried out weekly on a consecutive series of 200 cases of scarlet fever, during the whole period of detention in hospital, Dr. Gunn and I [10] found that 54% of the patients showed no change in the serological type of streptococcus present in the nose or throat; in addition to the primary type a second type was isolated in 40% of cases, and a third type in 6% of cases. In the group in which no change of type occurred, the average time of disappearance of the streptococcus from the nose and throat was 3·6 weeks, the average period of detention was 6·5 weeks, and 16% of the patients were still carrying the organism on discharge. Among those patients in whom there was an apparent change of type during the course of the disease, the average time of disappearance of the organism from the nose and throat was 5·9 weeks, the average period of detention was seven weeks, and on discharge, 62·6% of the cases were still carrying hæmolytic streptococci in the nose or throat. Among those harbouring the organism on discharge there were four times as many "throat-carriers" as "nasal-carriers," a reversal of the conditions usually found in diphtheria carriers.

Gunn and Griffith [11] have suggested three possible explanations of the change in type of organism occurring in a single case :—

(1) Instability of the serological characters of hæmolytic streptococci. Against this view are the facts that 54% of cases showed no change of type throughout, and when secondary infecting types appeared, they were, as a rule, isolated on repeated examinations.

(2) The influence of antibodies and local conditions *in vivo* may induce a change of type.

(3) Reinfection may occur from association with patients harbouring different types.

While it is impossible to exclude transmutation of type, the weight of evidence is in favour of reinfection, viz: (I) a higher proportion of reinfections occur late when the patients are convalescent and allowed to mix freely with other patients in the ward than during the first three weeks, when patients are confined to bed; (II) the occurrence of complications, such as tonsillitis, rhinitis, or otitis, is often associated with the appearance in the nose or throat of a fresh type; (III) in our experience, two cases of relapse, developing a second typical scarlatinal attack, with rash, sore throat, and temperature, showed different serological types of streptococci from those found in the primary attacks; (IV) patients, isolated by nursing in cubicles, show no change of infecting type throughout the disease.

Throat swabs from patients, taken immediately after admission to hospital, generally give a profuse growth of hæmolytic streptococci; cultures in many cases being almost pure. Cultures repeated at regular intervals usually show a gradual diminution in the proportion of hæmolytic streptococci present, until they disappear altogether, or show only a few scattered colonies on culture plates. The occurrence of reinfection with a fresh type is in some cases associated with the reappearance, following a negative culture, of large numbers of hæmolytic colonies, belonging to a type different from that causing the primary infection. As has been noted. this

group of cases has a very high discharge "carrier-rate" (62·6%), a factor which increases the probability of giving rise to "return-cases," although in our series no return-cases could be traced.

Gunn and Griffiths [11], in their series of 100 cases, found a total carrier-rate on discharge of 49%, while Gunn and I, in our series of 200 cases, found a carrier-rate of 52%. Observations made over a number of years indicate that the average rate of return-cases is 4%, and if we accept the average carrier-rate on discharge as about 50%, the question immediately arises from the small proportion of return-cases as to whether there is any change in the virulence or toxigenic powers of the hæmolytic streptococci from the onset of the attack to convalescence. We have tested the toxigenic powers of streptococci isolated from the nose and throat at various stages of the disease, and also from the desquamation scales, and no change has been found in the potency of the toxins produced. I also carried out some experiments on mice in order to ascertain whether there was any change in virulence, but the results were inconclusive, probably owing to the fact that insufficient strains were investigated, and the numbers of mice used were too small.

Many of the carriers showed only a moderate infection, and it is possible that the low return-case rate is, in some part, due to the altered environment of home conditions, leading to early abolition of the carrier state; the conditions in the ward, as may readily be understood, are conducive to persistence of the carrier state, especially when the convalescent patients are allowed to mix freely.

It is interesting to note that Gunn [12] observed a fairly definite and constant relation between the type of streptococcus and the severity of disease. This observation was fully confirmed by Gunn and Griffith [11] and later by Gunn and Allison [10] in their extensive series of cases. Dr. Gunn will deal more fully with the clinical manifestations in relation to serological type, but it may be noted that Type 1 and Type 2 organisms cause severe infections, with a tendency to complications, chiefly local in the case of the former, and mainly systemic in the latter. Type 3 infections are moderately severe and occupy an intermediate position between Types 2 and 4, the latter type being associated with extremely mild infections, free from complications.

Hæmolytic streptococci in the desquamation scales of scarlet fever.—The significance of the desquamation scales from scarlet fever as a factor in the transmission of the disease has long been a subject of discussion. Reports regarding the occurrence of hæmolytic streptococci in the scales are somewhat conflicting. Friedemann [13] examined the scales of fifty patients, and in only one case did he isolate hæmolytic streptococci, while Deicher [14] was unable to find streptococci in the scales of forty-nine patients during the seven weeks of illness. On the other hand Kanevskaya [15] in Leningrad found hæmolytic streptococci in the scales of thirty patients out of forty examined. Some time ago in collaboration with Dr. Gunn, I examined the desquamation scales of thirty-seven patients. The material was collected after the patients had had a bath, and clean sheets had been put on the beds. The specimens were removed with aseptic precautions and inoculated immediately into blood broth. Hæmolytic streptococci were isolated in ten instances (27%) and were typed as follows: Type 2, two strains; Type 3, three strains; Type 4, one strain; and heterogeneous types, four strains, indicating that the majority of the organisms, at least, were scarlatinal in type. Toxins were prepared from all ten strains, and these were found to be active, varying in strength from 2,500 to 12,500 skin test doses per c.c. when tested on suitable subjects; this indicates that all the strains were toxigenic enough to produce scarlet fever. The failure of Friedemann and Deicher to isolate the organisms in their series of cases was probably due to differences in technique and in the culture medium used.

The Toxins of Hæmolytic Streptococci.

It is generally accepted that the production of a soluble exotoxin, causing typical reactions when injected intradermally into susceptible human subjects is a characteristic of hæmolytic streptococci in general, and is not confined to scarlatinal strains. It is also agreed that the potency of the toxigenic powers of scarlatinal strains is more marked than in the case of non-scarlatinal strains.

The results of our investigations on the properties of toxins from scarlatinal streptococci agree in the main with those of other workers as regards medium for preparation, incubation time, heat resistance and keeping properties.

As already mentioned, clinical observations alone had revealed the fact that the four scarlatinal types of streptococci were associated with infections showing varying degrees of severity. The findings also suggested that the severity or mildness of the disease was tolerably constant for each serological type. We therefore investigated the toxigenic power of representative strains of the four types in order to ascertain whether there was any difference in the potency of the toxins produced.

The quantitative study of streptococcal toxins.—In our experiments we took as the unit of toxin the "skin test dose" as defined by Dyer [16]. The skin test dose was contained in 0·2 c.c. of inoculum, and controls consisted of the same solution heated for two hours at 100° C. and a skin test dose of a standard toxin. Each toxin was tested intradermally on a number of susceptible subjects, usually from 15 to 20 and not less than 10, and three or four dilutions of the toxin to be standardized were tested at the same time on the same subject. The toxins tested were prepared from 20 freshly isolated strains of scarlatinal streptococci, five strains from each of the four types. It was found that the toxins produced by the four types differed quantitatively from each other, but that the content was constant for each type. The toxin content in "skin test doses" (S.T.D.) per c.c. for the four types was as follows: Type 1—25,000 S.T.D., Type 2—12,500 S.T.D., Type 3—10,000 S.T.D., Type 4—1,500 S.T.D. per c.c. It has since been found as the result of testing a large number of toxins that strains belonging to Type 1 do not all produce an equally potent toxin; many toxins from Type 1 strains found in association with scarlet fever possess a potency of about 5,000 S.T.D. per c.c. but a few strains produced toxins containing only 1,000 S.T.D. per c.c. The respective potencies of toxins prepared from strains belonging to the other three types have been found to be remarkably constant, although the recent observations of Glover and Griffith [8] in school epidemics due to Type 2 and Type 3 suggest that these types are also subject to variations in toxigenicity.

The potency of upwards of 60 toxins from heterogeneous strains of scarlatinal streptococci has also been determined by skin tests. As was to be expected, there was no uniformity and the range of potency varied from 250 S.T.D. to 7,500 S.T.D. per c.c. Agglutinating sera were prepared for a number of these strains and those belonging to the same serological group produced toxins of equal potency. The absence of uniformity in the toxigenic powers is in keeping with the serological findings, as the great majority of these strains appear to be highly individualistic.

The conclusion may therefore be justified that the toxigenicity and serological constitution of hæmolytic streptococci, in association with scarlet fever at least, run parallel and serological typing may be regarded as a criterion of toxigenic power.

The qualitative study of streptococcal toxins.—It must be admitted at the outset that we are on less certain grounds in dealing with the qualitative differences between toxins produced by members of the hæmolytic group. Many authorities indeed, notably Parish and Okell [17, 18], deny categorically that there is any justification for assuming that qualitative differences exist. While it is difficult to adduce direct proof of qualitative differences, yet there is available a considerable

amount of evidence which, in our opinion, favours the hypothesis that such differences do exist.

In support of the unity of streptococcal toxins Parish and Okell claimed that scarlatinal and other streptococcal antitoxins could protect rabbits from the acute phase of septicæmia due to streptococci from scarlet fever, puerperal fever, erysipelas, or pyogenic infections, although the best protection in all infections was afforded by the scarlatinal antitoxin.

On the other hand, the work of Davis [19] and Pilot and Dreyer [20], on the toxins of the scarlatinal streptococcus and of the so-called *Str. epidemicus* from an outbreak of epidemic sore throat in America, affords strong evidence of the existence of qualitative differences between streptococcal toxins. They claimed that persons convalescent from scarlet fever and Dick-negative, gave positive skin reactions to the toxins of *Str. epidemicus*; similarly, subjects susceptible to both toxins became negative to scarlet fever toxin following immunization with that toxin, but still gave a positive reaction to *Str. epidemicus* toxin.

Singer and Kaplan [21] carried out cross-neutralization experiments on the toxins and antitoxins prepared from streptococci from scarlet fever and erysipelas, tested by the intradermal injection of susceptible subjects. They found a lack of absolute specificity between the toxins and antitoxins, but suggested that a relative specificity was present, with evidence of overlapping.

The observations carried out on the Schultz-Charlton reaction by Gunn and Griffith [11] and Gunn and Allison [10] suggest that the numerous failures of the Dochez antitoxin, suitably diluted, to blanch the rash of scarlet fever, may be due to differences in the combining properties of toxins from different serological types of scarlatinal streptococci. The Dochez antitoxin was observed to exert a highly specific blanching action (100%) towards Type 3 rashes (27 cases) even though the intensity and duration of the rash were shorter than found in Type 1 or Type 2 groups. The large proportion of rashes in the Type 2 group which were not blanched by the antitoxin (10 out of 23) supports the view that qualitative differences exist between the toxins producing the rashes. Convalescent serum from a patient suffering from a Type 2 infection produced pronounced blanching of rashes associated with Type 2 strains, fewer and less clear-cut reactions with Type 1 rashes, and very variable results in Type 3 and 4 groups, but unfortunately the antitoxin content of the serum was not sufficiently high for the tests to be decisive.

Observations on the Dick reaction in convalescent patients also afford evidence which suggests the existence of qualitative differences. Type 2 cases show a relatively severe infection, and the proportion of Dick-positive reactors on admission (80%) shows a rapid fall until discharge (2%), indicating active production of antitoxin. On the other hand, Type 4 infections are extremely mild, and immunity as shown by the Dick reaction is slowly produced; 100% of cases gave positive reaction on admission and 11% on discharge. It might be inferred from these figures that the greater immunity response in Type 2 infections is due to the fact that Type 2 strains are more highly toxigenic than Type 4 strains. On the other hand, the observation that the positive Dick reaction is quickly abolished in Type 2 infections suggests that the antitoxin produced is better constituted to neutralize the Dick toxin than that produced by Type 4 infections.

Further evidence of qualitative differences between the toxins of scarlatinal streptococci was afforded by a comparison of the dermal reactions to a skin test dose of each of the four type toxins in completely susceptible subjects, and in partially immune patients, convalescent from scarlet fever. Chart 1 shows graphically the dermal reactions in a completely susceptible subject to the four type toxins, the inoculum being 0·2 c.c. of a 1-1000 dilution of each toxin; Type 1 toxin is seen to be the most potent, followed by Types 2 and 3, while Type 4 toxin is very weak. Chart II shows the dermal reactions of a completely susceptible subject to

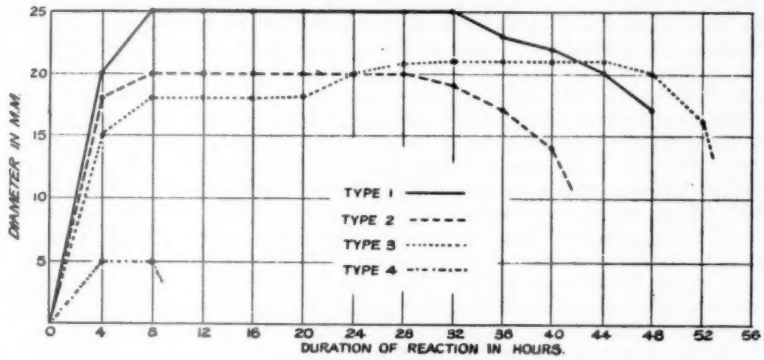

CHART I.—To compare the potencies of the four type toxins in a completely susceptible subject. (0·2 c.c. of a 1 in 1,000 dilution of each toxin given intradermally.)

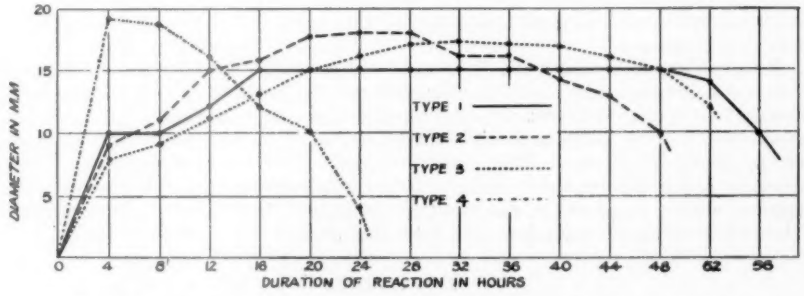

CHART II.—To show the reactions produced by *one skin test dose* of the four type toxins in a completely susceptible subject.

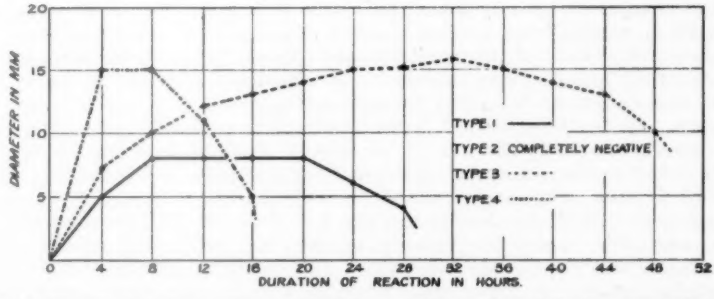

CHART III.—To show the reactions produced by *one skin test dose* of the four type toxins in a partially immune subject, infected by a Type 2 scarlatinal streptococcus.

one standardized skin test dose of each of the four type toxins; attention may be drawn to the sudden rise, short maximum and rapid disappearance of the reaction due to Type 4 toxin as compared with reactions produced by the other three Type toxins, which show a gradual rise and prolonged maximum, followed by fading. Chart III shows the dermal reactions to one standardized skin test dose of each of the four type toxins, of a partially immune subject convalescent from scarlet fever due to a Type 2 streptococcus; in this case the Type 2 toxin shows a completely negative reaction, while the other three type toxins produce well-marked positive and characteristic reactions, only slightly weaker than those found in a susceptible subject. The reactions indicate that the antitoxin produced in the patient's blood by the infecting strain (Type 2) has completely neutralized the skin test dose of Type 2 toxin, and has only slightly weakened the characteristic reactions produced by the other three type toxins. This result is very suggestive of qualitative differences between at least Type 2 toxin and the other three Type toxins, with some evidence of overlapping.

Further support of this hypothesis was afforded by a series of skin neutralization tests carried out with the toxins of the four serological types, and a standard antitoxin of known potency for the toxin-antitoxin mixtures. It was shown conclusively that Type 3 toxin was most readily neutralized by the antitoxin employed, and Type 4 least so, while Types 1 and 2 toxins occupied an intermediate position.

Similarly, using antitoxins prepared from Type 2 and Type 3 toxins, it was found that the homologous antitoxin neutralized its own toxin at higher dilutions than the other type toxins.

It seems probable that further work on the streptococcal toxins will show that while a considerable amount of overlapping occurs, qualitative differences do exist between toxins from different strains of scarlatinal streptococci, as well as between toxins from strains associated with conditions such as erysipelas, puerperal fever, and pyogenic infections. The results suggest that the toxins have a complex structure, and if further work confirms this view, the streptococcal antitoxin of the future should be a polyvalent one produced from the toxins of hæmolytic streptococci, isolated from different infections and belonging to different serological types.

Tonsillitis.

There can be little doubt that tonsillitis is one of the most important local manifestations of infection with hæmolytic streptococci. Attention has frequently been drawn to the close resemblance between acute tonsillitis and scarlet fever. If from the clinical picture of scarlet fever we omit the rash, which results from the action of toxin, the similarity is very striking. It is a not uncommon experience for an attack of scarlet fever in one member of a household to be preceded by the occurrence of tonsillitis or pharyngitis among other members of the same household, suggesting that the same organism may be associated with different clinical conditions.

The occurrence of tonsillitis in children is probably more frequent than is suspected. In the laboratory I have been struck, especially during the epidemic season for diphtheria, by the number of cultures received between the second and fifth day of illness from cases admitted to fever hospitals as diphtheria. The great majority of these cultures gives an almost pure growth of hæmolytic streptococci with absence of diphtheria bacilli, and the fact that the cultures were sent to the laboratory at this stage of the disease, suggests that the medical officers concerned did not agree with the outside diagnosis of diphtheria. Such cases would appear in the official returns as diphtheria, when in reality they were cases of acute streptococcal tonsillitis.

Griffiths [6] and Smith [22] have both isolated scarlatinal types of hæmolytic streptococci from the throat in cases of acute tonsillitis. I isolated a Type 2 strain

from my colleague, Dr. Gunn, during an acute attack of sore throat; the organism produced a potent toxin, and as Dr. Gunn was Dick-negative, it was evident that his antitoxic immunity was no protection against invasion. This factor is probably of considerable importance in the correlation of tonsillitis and scarlet fever, and in this connection the investigations of Glover and Griffith [8] into school epidemics of acute tonsillitis due to hæmolytic streptococci are of unusual interest. Their observations, with which Dr. Gunn will deal in more detail, show that epidemics of acute tonsillitis may be due to scarlatinal types of streptococci, having a very low toxigenic power, and indicate the value of serological typing as a means of identifying the causal organism in tonsillitis, and especially in epidemics, of studying the method of spread, and the varying clinical manifestations and complications associated with a particular serological type. The evidence of these workers indicates that infection of the throat by hæmolytic streptococci may range from healthy carrier through tonsillitis, febricula, and pharyngitis, to scarlet fever; the latter infection is associated with the more highly toxigenic members of the group, which however only produce scarlet fever when their toxigenic powers are sufficiently high to overcome the antitoxic immunity of the host.

Puerperal Fever.

Recent work on the bacteriology of puerperal fever has implicated the hæmolytic streptococcus as the infecting agent in the great majority of cases, and in practically all fatal cases of puerperal septicæmia. Kinloch, Smith, and Stephen [23] isolated the organism from uterine cultures in 49 out of 56 cases (87·5%) of puerperal fever, and from the blood in 28 out of 31 positive cultures from 86 patients. In a series of 36 cases of puerperal fever which I examined bacteriologically the hæmolytic streptococcus was isolated as the infecting organism from 30 (83·3%). Many workers (Fromme [24], Kanter and Pilot [25], Lockhart [26]) have examined the flora of the vagina during the puerperium and before and after labour, and their results show that during the puerperium and immediately prior to labour, the hæmolytic streptococcus is present in rather less than 1% of cases, which is in keeping with the belief that exogenous is of greater importance than endogenous infection. The history of puerperal fever can show many instances where epidemics of this infection, occurring in lying-in hospitals, have been traced to infection from without. Smith [27] has shown that in no less than 12 cases of puerperal fever and septic abortion, out of a total of 21, the infecting strains of hæmolytic streptococci originated in the throat or nose of the doctor, nurse or student in attendance. More recently, I [28] isolated a Type 1 and a Type 3 scarlatinal streptococcus as the infecting organisms from two cases of puerperal fever, and also cultured the same serological types of organisms from throat swabs of midwives in attendance upon the respective patients. In one case I have also found a Type 2 scarlatinal streptococcus as the cause of puerperal fever. These results, and those of Smith, confirm the importance of the throat as a vehicle of infection in puerperal cases, and support the recommendation of the Ministry of Health in the Interim Maternal Mortality Report (1930) that there should be a wider use of masks and more effective antiseptic precautions by persons in attendance on midwifery cases. Infection of the puerperal patients by strains of streptococci, associated with scarlet fever, from the throats of persons in attendance, probably accounts for cases of puerperal scarlet fever which sometimes occur. I have prepared toxins from several strains of hæmolytic streptococci from puerperal fever, and skin tests have shown that they were active, although the potency fell, as a rule, considerably below that of the scarlatinal toxins. Most of the toxins of puerperal streptococci, tested by Smith, had a potency of about 5,000 S.T.D. per c.c., but the highest toxin content I have found was 2,500 S.T.D. per c.c. This suggests, in view of the high mortality,

that the puerperal streptococci depend, for their pathogenic action, to a greater extent on their invasive properties than on their toxigenic power.

Erysipelas.

Erysipelas is the classical example of acute streptococcal infection, and is remarkable in that one attack confers little protection against subsequent infection. This peculiarity is also often seen in tonsillitis among streptococcal infections, and in boils and the "common cold" among non-streptococcal infections.

Tunnicliff [29] and Birkhaug [30] claimed to recognize serological groups among streptococci from erysipelas and state that they show a high degree of specificity. Much of their work remains unconfirmed, and Stevens and Dochez [31] in a careful study conclude that while hæmolytic streptococci from erysipelas form a closely related group, and scarlatinal streptococci also form an equally compact group, the two groups are related antigenically. Smith [22] found a Type 1 scarlatinal streptococcus as a cause of erysipelas on one occasion, but I was unable to recognize any scarlatinal types among a series of twelve erysipelas strains examined. Smith also pointed out from an examination of the case-rates of scarlet fever, erysipelas and puerperal fever in England and Wales, and in Scotland, between the years 1911-24, that there is a marked increase in the incidence of erysipelas when scarlet fever is epidemic, while the case-rate for puerperal fever shows no such fluctuations.

It is worthy of note that erysipelas is an extremely rare complication of scarlet fever, despite the fact that the latter disease is not infrequently complicated by conditions such as streptococcal rhinitis with excoriations and ulceration of the nares, impetigo contagiosa, and streptococcal onychia. It would appear therefore that the erysipelas group of streptococci possess a high degree of specificity in the nature of the infection they produce, and that antitoxic immunity is not effective against invasion of the skin by these strains.

Hæmolytic Streptococci as Secondary Invaders.

Hæmolytic streptococci may occur as secondary invaders in almost any infective disease, and under such conditions may be of considerable epidemiological importance. Recently I examined, in collaboration with Dr. Gunn, nasal and throat swabs from 100 consecutive cases of diphtheria for the presence of hæmolytic streptococci. The swabs were taken on admission to hospital and hæmolytic streptococci were isolated from the nose or throat in sixty-two cases. A similar series of swabs from 100 cases of measles yielded hæmolytic streptococci on thirty-two occasions. None of the ninety-four strains isolated were found to belong to any of the four main types of scarlatinal streptococci. Apart from these two series of cases, I have on one occasion isolated a Type 2 scarlatinal strain from an empyema following measles and a Type 2 strain has also been found as a secondary invader in the throat in a case of diphtheria. It is probable that such strains are associated with outbreaks of scarlet fever in diphtheria and measles wards.

Hæmolytic streptococci are also important as secondary invaders in many of the acute respiratory infections. Williams, Nevins, and Gurley [32] studied the nasopharyngeal flora in persons suffering from the common cold and from influenza, as compared with the organisms present in normal subjects. Normal persons harboured the hæmolytic streptococcus in 6% of cases, persons suffering from colds in 16% of cases, and influenza patients in 27% of cases. In secondary broncho-pneumonia following influenza, Dwinell [33] found, in sixty-nine autopsies on fatal cases, the hæmolytic streptococcus present in 59% of cases, Pfeiffer's bacillus being second in order of frequency with 49%. There is little doubt

that a considerable proportion of complications and fatal terminations to these infections is due to the implantation of a virulent strain of hæmolytic streptococcus on the primary infection; the local conditions are probably so altered by the action of the primary invader as to favour infection by this organism. The frequency with which the hæmolytic streptococcus occurs as the cause of complications in influenza, measles, and, occasionally, diphtheria, may be associated with the increase in the carrier-rate and spread of the organism seen especially during epidemics.

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II.—Dr. William Gunn.

Although a vast amount of research and a flood of literature have been focussed on the streptococcal infections in recent years, we feel that no apology is needed for bringing this subject up for discussion before the Section, for the streptococcus admittedly occupies a high place, possibly chief place, in the production of human disease. Each fresh study only serves to widen the apparent range of its activities both in acute and chronic conditions, and, even now, our knowledge is still nebulous in many directions, especially in respect of the milder grades of streptococcic invasions. While we propose to direct our survey chiefly to infections which tend characteristically to attain epidemic proportions and in which the streptococcus is accepted as the causative organism, we cannot ignore a large number of infective conditions in which the streptococcus is only probably the primary agent, in which it is merely a secondary invader, or in which the tendency to epidemicity is not always apparent.

Dr. Allison has already described the cultural, biological and serological characteristics of the hæmolytic streptococcus; he has explained why the discussion is being restricted to it, to the exclusion of viridans and fæcalis strains, so that it is unnecessary for me to deal with the strictly bacteriological aspect of our subject, except to examine the bearing of special properties of the streptococcus in the causation of diverse clinical conditions.

In common with other pathogenic micro-organisms, the streptococcus must needs possess certain definite properties before it can successfully invade a population and cause manifest disease therein. Two serious difficulties are encountered at the

outset in identifying the streptococcus as the causative organism in any disease. In the first place, it is an almost constant inhabitant of the human nose, throat or nasopharynx, and its distribution is world-wide; to assess its pathogenic importance in a given case may therefore be difficult, at times even impossible. In the second place, for its identification and proof of pathogenicity, complicated and laborious tests involving the human subject are necessary, as laboratory animals are practically all immune to the toxins of the organism. Recent work on the toxigenicity and virulence of streptococci has widened our knowledge of these properties in certain well-defined diseases, but it can hardly be held to simplify matters. Indeed, the reverse would seem to be true, and the "streptococcus problem" appears to increase in complexity the further we advance.

It is therefore imperative that we should be clear and exact in our use of terms, especially when discussing those problems which equally concern the bacteriologist, on the one hand, and the clinician and epidemiologist on the other. For instance, the term virulence, to the bacteriologist, means the power to invade, and multiply in, the tissues of the host, including the blood-stream, while, by the clinician, the term is usually employed to include all the pathogenic properties of the organism, and is associated intimately in his mind with severity of disease. It will possibly be worth while discussing at this juncture the modes of transmission of infective disease and the mechanism of infection and immunization, in order to meet our problems openly, if we cannot hope to solve them outright.

The natural habitat of the streptococcus is the nose, nasopharynx, and mouth of the human subject; here it finds a suitable pabulum, for a time at least, multiplying and provoking certain local reactions which are frequently on the boundary line between the physiological and the pathological. After a brief period, from seven to ten days or so, the organisms tend to diminish in numbers, and gradually die out in three to five weeks. By the use of highly selective media, however, it has been shown recently that hæmolytic streptococci in sparse numbers can usually be obtained in most individuals for long periods, and that not merely during times of unusual prevalence of scarlet fever or tonsillitis. The human subject is the great reservoir of the organism and no method of diminishing the incidence of streptococcal infections can succeed unless this fact is taken into account. In the past undue attention was paid to the part played by inanimate carriers, or fomites as they were called, in the propagation and dissemination of human disease. We know now that such foci are relatively ineffective; multiplication rarely, if ever, occurs, except in a few special vehicles such as milk, and exposure to sunlight and drying rapidly diminishes their numbers and probably tends to attenuate their virulence. The human subject spreads infection by coughing, sneezing and spluttering, whereby mucus charged with organisms is projected in the form of droplets. Being in a particulate state and heavier than air, these tend to sink to the ground under the influence of gravity but may be carried a considerable distance in a highly infective state, especially when air currents are present. In this manner may be explained the great risk of infection in overcrowded workrooms, places of entertainment and dormitories; this risk is probably increased by a free current of air, even of fresh air. Dormitories were first implicated as forming a suitable environment for the spread of streptococcal infections in a positive manner by Bloomfield and Felty in 1923, when they found that tonsillitis broke out afresh when the sleeping accommodation of nurses was rearranged so that they came into contact with a new set of room-mates. It was shown that the close contact of a sleeping room was necessary to bring about infection, whereas the ordinary casual contact of the wards and day-rooms was not enough. Just recently Glover and Griffith (1931) have stressed in convincing fashion the paramount importance of such intimate contact in spreading infection. The difficult problems of dosage and effective contact have been studied in detail by Dudley (1923). He has shown that a certain minimal dose, the critical

dose, of a virus is necessary to cause manifest disease. A smaller dose is probably a frequent event but it is rapidly eliminated or destroyed by the defence mechanism of the body—the healthy mucous membrane and the intact skin, in the first place. If the subject receives a succession of sub-minimal doses, which added together is greater than the minimal infecting dose, the balance between rate of infection with these fractional doses and the rapidity of destruction or elimination of the virus must determine whether or not the subject develops the disease. Successful invasion merely implies implantation of organisms on and between the body cells; to secure infection there must follow multiplication of the organisms and penetration of the tissues by them, with production of manifest disease. Where infection has taken place without the accompaniment of recognizable disease the term sub-infection or latent infection is commonly applied. In the streptococcal infections this latent infection and subsequent immunization, or, it may be, increased susceptibility, are characteristic features and explain the apparent vagaries of attack and escape in a given population. As the streptococcus is ubiquitous, we are all frequently invaded, but infection only supervenes when there is temporary lowering of our defences, local or general.

While the mechanism of infection has been studied in detail and the theories underlying it have been placed on a sound scientific basis, we are on less sure ground when we face the problems of identification of strains of the invading organisms and possible variations in their pathogenicity. Landmarks in the work of identifying the hæmolytic streptococcus were made by Baginsky and Sommerfeld in 1900, by Dochez and Bliss in 1920, and by Griffith, Smith and James in 1926. The first named workers introduced the method of classification of scarlatinal strains of hæmolytic streptococci by serological methods but they were only partially successful and further attempts were abandoned for some time. Dochez and Bliss claimed to have been able to assign all streptococci from scarlet fever cases into a single serological group. The advantage of this would be enormous but, unfortunately, subsequent investigations proved their claims to be invalid. By the discoveries of the Dicks a fresh impetus was given to the study of the hæmolytic streptococci all over the world. Griffith, Smith and James, working independently, although they exchanged cultures and sera, found that they were able to assign nearly two-thirds of the strains associated with scarlet fever in this country into four well-defined and sharply demarcated serological groups, named by Griffiths, Types 1, 2, 3 and 4, respectively, while there remained a number of strains, roughly one-third, which they failed to classify, either because they were highly individualistic in antigenic structure or because they possessed but little capacity to infect. It was assumed, although positive proof was not available at the time, that by these methods a large proportion of scarlatinal strains, or at least, of strains potentially capable of producing scarlet fever, could be identified with certainty.

Nearly a year after their investigations were published I collected the clinical data regarding the patients from whom Dr. Griffith's swabs were taken and, on analysis, found that Type 2 infections were the most severe and included nearly all the cases of nephritis, rheumatism and endocarditis; Type 1 cases displayed considerable variability in degree of rash and severity of initial attack, but a high incidence of local complications such as adenitis, otitis and mastoiditis; Type 3 infections were of moderate severity and represented fairly closely the moderate or mild type of scarlet fever prevalent within recent years, while Type 4 infections were invariably mild, never causing any complications, local or constitutional. When complications did occur in association with Type 4 infections, evidence of reinfection by a more highly toxigenic strain was found in every case in the throat or nose and in the local lesion, e.g., otitis. Considerable diversity was observed, as might be expected, in the unclassified group, both in respect of the character of the initial attack and of the occurrence of complications, but, as a rule, those strains

were associated with mild clinical forms of the disease. The same close relation between serological type and severity of associated infection was observed in three separate series of scarlet fever cases examined during the period of seasonal prevalence in three successive years and fully confirmed the previous findings (Gunn and Griffith, 1928; Allison and Gunn, 1928-29).

The toxin-producing power of representative strains of the four main serological types was determined by the usual methods of assay; the results were found to be in agreement with the clinical findings, even in respect of the toxigenic differences shown by certain Type 1 strains with which some difficulty in serological classification was encountered. In other words, the strains elaborated *in vitro* an amount of toxin which was compatible with the clinical manifestation of infection in the human subject produced by the same organisms. Not only did the four types produce different amounts of toxin which were constant for each type, but all the evidence, clinical and experimental, favoured the view that important qualitative differences existed between these toxins which were responsible for the different clinical types of disease and for the inconstant therapeutic effect of a monovalent serum. As all the serological types we examined were derived from scarlet fever cases, or from infections in which a scarlatinal source could not be definitely excluded, and as all the strains returned a constant toxin value for each group, we concluded that all members of each serological group were capable of causing scarlet fever under suitable conditions. A grave defect of our investigations was our inability to classify and identify strains of hæmolytic streptococci from extra-scarlatinal sources, e.g., measles, diphtheria, and influenza, although these organisms were probably quite as infectious as the scarlatinal or classifiable types. Moreover, the existence of overlapping of antigenic constituents in certain typed strains and the possibility of intermediate strains between the four main groups presented such serious difficulties to many workers, notably McLachlan and Mackie (1928), that they are inclined to doubt the value or validity of serological typing.

Such was the state of the streptococcus problem from the serological viewpoint, when an important paper appeared on the incidence of tonsillitis and allied infections in certain public schools in this country. This work, I venture to predict, will, at no distant date, be regarded as an epoch-making one in the history of streptococcus research. Drs. Glover and Griffith (1931) investigated several epidemics of tonsillitis, scarlet fever, and rheumatic fever, and correlated the clinical data with the strains of hæmolytic streptococci associated with each outbreak, using agglutination methods for their identification and classification. Several of the outbreaks of tonsillitis were caused by classified strains belonging to Types 1 and 2, but in some instances new types emerged, as invasive, as infectious, and even as highly toxigenic in some instances, as representatives of the main serological groups. The manner of spread of infection caused by a single strain, sometimes over long periods, was followed in several outbreaks, and it was conclusively shown that it was determined principally by the close spacing of beds in dormitories. Important—and, as it appeared to the observers at the time, conflicting—observations were made on the varying reactions of different individuals to the same infecting agent. In one subject the result was frank scarlet fever, in another, tonsillitis, in a third, influenza or febricula, and in a fourth, a symptomless infection. These diverse clinical conditions, and especially the low incidence of scarlet fever in many of the outbreaks associated with classified strains, were attributed at first to the high antitoxic immunity of the population attacked. While this explanation would account for many apparent inconsistencies, it was regarded as highly improbable, for it is well known that the antitoxic immunity of the well-to-do classes is usually low, and the results of Dick-testing the boys in two of the schools fully confirmed this. They were therefore forced to the hypothesis that many of the classifiable strains they examined had partially or completely lost their toxigenicity, but when their paper was published they had not had an opportunity

of determining the toxin-producing powers of these strains. I have since then investigated the toxigenicity of all the strains in question, and the results have furnished a complete explanation of the apparent discrepancies between serological type and the clinical condition associated therewith. It was ascertained that certain strains belonging to the four main groups (only Types 1 and 2 were encountered in these outbreaks) had lost their Dick toxin-producing power but apparently retained unaltered their invasive and infective properties, so that the incidence of otitis, mastoiditis, &c., was high in many instances. We have had no evidence, so far, to show whether these atoxigenic strains of the serological group represent the natural or primary state of the species, or whether they have undergone degradation of toxigenicity by the natural process of dilution, by separation from their host, or by contact with an immune host.

These investigations have opened up new fields of inquiry into the nature of the poison elaborated by the hæmolytic streptococcus. Since the discovery of Dick toxin, interest was focussed mainly on the erythrogenic fraction, but it would now appear that this is only a small, and probably relatively unimportant, part of the streptococcus toxin. Its existence in a given strain, so far from constituting a danger, actually is a boon, for it provides a friendly warning of the presence of a deadly enemy, which can only be combated by timely medical and nursing care. The insidious atoxigenic strains appear capable of producing all the complications we usually associated with frank scarlet fever, with the possible exception of nephritis. The series investigated is too small to warrant any conclusions on this latter point.

A broader conception of the pathogenic activities of the hæmolytic streptococcus is needed, as each fresh investigation produces further evidence of its manifold variations. A convenient clinical classification of streptococcal infections has been made by Glover and Griffith, viz.: (1) Symptomless infection or the healthy carrier state. (2) Febricula, feverish catarrh or pharyngitis, without noticeable sore throat or tonsillar involvement. (3) Tonsillitis of varying degrees of severity. (4) Scarlet fever.

The clinical condition encountered in a given epidemic is determined by the invasiveness and toxigenicity of the invading streptococcus and the state of immunity or otherwise of the population attacked. If the proportion of Dick negative reactors is high, then scarlet fever will be infrequent or absent, however high the toxigenicity of the strain, but, on the other hand, an atoxigenic strain cannot produce scarlet fever, however susceptible the population, unless exaltation of toxigenicity occur by repeated passages. So far, we have not observed this phenomenon. On the other hand, there appear to be grounds for believing that increase in invasiveness does occur, but in the absence of a specific test of susceptibility to invasion no conclusion is warranted. In collaboration with Dr. Griffith, I have carried out some experiments with emulsions of bacterial protoplasm prepared from highly invasive but atoxigenic strains of hæmolytic streptococcus isolated during these outbreaks, and the results of intracutaneous injection are suggestive of some connection between sensitivity to the "endotoxin" and liability to invasion. Most children, even those who give a strongly positive Dick reaction, are quite insensitive to endotoxin, while adults, particularly if prone to tonsillitis, tend to be highly sensitive, irrespective of their response to Dick toxin. Endotoxin differs from Dick toxin in being relatively heat-stable and unneutralizable by antitoxin. It remains to be seen whether the endotoxin reaction is simply an allergic phenomenon, indicating sensitization to bacterial protein, or whether it is a reliable test of immunity or otherwise to invasion. Collins (1931) has recently investigated the action of a similar endotoxin prepared from strains of hæmolytic streptococci found in association with rheumatic fever. He has shown that rheumatic patients are much more sensitive to the product than a series of

controls, and he has adduced evidence to suggest that acute rheumatism probably represents an allergic state, following streptococcal tonsillitis at an interval of from ten to twenty-one days—the so-called "silent period."

This brief survey of the properties of the hæmolytic streptococcus and the possible reactions of the human body to its activities may enable us to appreciate how apparently the same organism may cause such widely diverse clinical conditions as puerperal fever, wound and burn—scarlet fever, cellulitis, erysipelas, impetigo contagiosa, and the nasopharyngeal and respiratory complications of measles, influenza, diphtheria and whooping-cough—to mention but a few. The reservoir of infection is the nose, nasopharynx and throat of the human subject and the different clinical states it produces depend upon: (1) the specific properties of the organism, which differ for each strain; (2) the site of implantation and invasion, and (3) the resistance, local and general, of the host. Should a highly toxigenic strain invade a Dick-positive reactor, whether the site be skin, uterus, or throat, a general rash results; to this rash-producing toxin the body cells prepare an antitoxic immunity which usually lasts during life. On the other hand, the human body produces little antibody in response to invasion locally; if such is evoked, it appears to be transient, and is frequently succeeded by a period of lowered resistance. The immediate task before us is to seek out the means whereby resistance may be raised in anticipation of invasion, or succour may be provided at the height of the battle, by the administration of an efficent anti-bacterial serum.

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Discussion.—Dr. J. E. MCCARTNEY said that a considerable amount of work had been done in connection with the paper and many hundreds of strains of hæmolytic streptococci had been examined. The results of the investigation showed quite definitely that quantitative and qualitative differences in the toxins did occur, and these might account for diversity in the clinical picture. The epidemiological value of typing the strains was great. The technique of typing gave a clear-cut result and the agglutination between the streptococci and type sera is just as pronounced and clear as the agglutination of the red blood-cells for blood grouping. The value of typing was that it enabled a strain of hæmolytic streptococci to be traced from person to person in an epidemic. [Dr. McCartney cited a recent instance in his own work.] A noteworthy point was the absence of Type 2 infections in the United States and on the Continent. This was similar to the findings in pneumococcal types, of which the prevalent types in New York were quite different from those responsible for pneumonia on the Rand. Similarly, Type 2 strain, although an epidemic strain here, was rare or absent abroad. Some of the heterogeneous strains in this country would belong to epidemic types in others. An important fact to bear in mind when correlating bacteriological and clinical results, was that the toxigenic power, i.e., ability to produce an exotoxin, bore no definite relationship to virulence, i.e., power of invading and causing disease. If a recently isolated hæmolytic streptococcus were tested, it would be found to produce a powerful toxin as tested in man, and be capable of killing a mouse in high dilutions when injected into that animal. When the organism was successively cultured in artificial media it still produced a powerful exotoxin, but quickly became progressively weaker in its power of affecting the mouse until finally very large doses of the organism might not suffice to kill the animal. It should be realized that the toxigenic power was tested on humans who were susceptible, whereas the virulence tests were carried out on animals (rabbits and mice), for toxigenic capacity and

virulence could only be compared by tests on the same species. The differences in toxigenicity and virulence would help to explain why the hæmolytic streptococcus gave rise to a diversity of clinical conditions, e.g., scarlatina, tonsillitis, erysipelas and puerperal fever, and why each disease, when passed from one human to another, bred true.

Dr. E. W. GOODALL said that while listening to this interesting and suggestive paper a suspicion had crept into his mind that perhaps, after all, we had not got hold of the real cause of these diseases, and especially of scarlet fever. As Dr. Gunn had admitted, there were sceptics to be met with. He (the speaker) remembered Proteus X 19, which though not the cause of typhus, was yet agglutinated by typhus serum. Therefore was not the idea held by most clinicians till recently, right after all—namely, that the true cause of scarlet fever was not known and that the cocci were only secondary invaders? On the other hand, we had to admit that a toxin had been obtained which produced fever and the characteristic rash of scarlet fever in the human subject. That experiment, and others which derived from it, seemed to place the streptococcus as the true cause of the disease.

Dr. Gunn had said that definitions were necessary, a statement with which he (Dr. Goodall) quite agreed. He would therefore ask Dr. Gunn to define more exactly what he meant by the word "mild" and "severe" as applied to scarlet fever, as they evidently differed widely from his, the speaker's, use of them. He preferred the old classical and clinical words "benign" (or "mild"), "anginous" (or "septic"), and "malignant" (or "toxic"); and he suggested that in any future observations on the connection between the form of the attack and the type of coccus, those terms be used. Had Dr. Allison and Dr. Gunn had the opportunity of investigating a case of malignant scarlet fever? The investigation of such a case ought to yield valuable results. He would also like to have an exact definition of the terms "virulent" and "power of attack or invasion." He was surprised to hear that the virulence of a micro-organism had nothing to do with its toxicity.

The rash of scarlet fever was produced by the toxin of certain cocci. But it was to be remembered that there were other sorts of rashes, due, apparently, to these organisms. They had been observed, especially, in some of the severe outbreaks of milk-borne origin, of acute faucial inflammation in which streptococci were said to be the offending organisms. They had also been described as secondary rashes in scarlet fever. Were they due to a special toxin or to a protein such as had been mentioned by Dr. Gunn?

Turning to the epidemiological side of the paper, we knew that scarlet fever had been recognized as a distinct disease since Sydenham's days. Since then it had undergone various changes in severity. About seventy years ago it began to grow less severe and that decline had been going on ever since, till at the present day the disease was perhaps milder than it ever had been. According to the views advanced that evening it was clear that in past times a very toxic type of coccus must have been in the ascendant which now had disappeared. But as scarlet fever was still as prevalent as ever it was, the toxic type must either have been changed into—or been replaced by—a mild one. The discussion of the cause of that alteration raised the question whether the changes took place in the seed or in the soil. Of recent years opinion seemed to have been gaining ground that changes in external conditions, such, for instance, as those imposed by the weather, affected the soil, i.e., the human being, rather than the seed, i.e., the micro-organism. The observations related that evening showed that alterations took place in the seed by whatever means those alterations were brought about. In a series of cases occurring during the years 1905-14, analysed by Professor Greenwood and Mr. Russell, the data having been provided by himself (Dr. Goodall), it was found that the septic variety of the disease had a different seasonal prevalence from that of the mild. That fact seemed to show that changes in the seed were responsible for some of the changes in the epidemiological behaviour of the disease, but while he was inclined to attribute some importance to changes in the seed, yet equal, if not more, importance was to be attached to the influence of the environment upon the soil, considered individually and in the mass.

Dr. V. D. ALLISON (in reply) said it was important to realize that the Dick test was an index of susceptibility or immunity to the exotoxin of hæmolytic streptococci, and that the toxin was only one factor in the production of the clinical picture. Another, and in many cases more important, factor was the invasive power of the infecting strain, and a test of susceptibility or immunity to this action would be of considerable value. In this connection the recent work of Collis was very interesting; he gave intradermal injections of ground-up streptococci or "endotoxin" to children, who had had a recrudescence of

rheumatic symptoms in a hospital ward, following an epidemic of tonsillitis due to the hæmolytic streptococcus, and he found a remarkably high percentage of positive reactors, as compared with a series of control cases.

In reply to Dr. Goodall: he had not been successful in isolating hæmolytic streptococci from the blood during life, in a series of about twenty cases of scarlet fever, mainly severe in type, although he had isolated the organism on several occasions, after death, from the heart blood.

Section of Anæsthetics.

President—G. Ramsey Phillips.

[*March 5*, 1932.]

Anæsthesia for Major Throat Operations.

By Claude W. Morris, M.B.

I propose in this paper to consider the methods of giving anæsthetics in operations about the upper air-passages, and in the first place to give an account of the methods adopted for anæsthetizing in the operation devised by Mr. Wilfred Trotter for dealing with malignant growths in the hypopharynx.

This operation, sometimes known as the lateral pharyngotomy, is planned to give a free access to and a clear exposure of growths arising round the upper aperture of the larynx, the sinus pyriformis, and the post-cricoid region and lateral walls of the pharynx. It is also devised to repair and effect continuity of the pharynx by a skin-flap, after removal of a portion of its lumen. It is further used to repair the pharynx from the result of trauma, in the somewhat rare occasions when that occurs.

It is clear that, from an anæsthetic point of view, these patients present difficulties which entitle them to be considered in a definite class by themselves.

The following difficulties may be met with: Firstly, there may be some degree of obstruction to the patient's respiration, due to restriction of the air passage by the growth. Secondly, and the most important of all, is the very grave threat of lung complication following the operation. And thirdly, it is necessary to give the anæsthetic in such a way as to allow the surgeon the maximum degree of freedom for his field of operation, without hampering him with apparatus.

These are some of the obvious difficulties met with in this group of cases, and the following are the methods employed to overcome them:—

Taking first the difficulties due to obstruction, we have to consider carefully the degree to which this may be present, and to base our line of action upon the result of our observation. The obvious case, with stridor and cyanosis, occasionally met with, proclaims itself unmistakably, but in addition to this obvious case there exists a large number of minor degrees of obstruction which must be recognized.

Patients seldom admit that they have difficulty in breathing; they may be unaware of the fact themselves in minor cases, and it is only by closely questioning them that it is possible to elicit the fact that they are at times a little short of breath, or that, for instance, they prefer to sleep with their heads rather high, as they find it easier to breathe in that position.

A failure to recognize the presence of a mild degree of obstruction may lead to considerable difficulties when the anæsthetic has been started as, owing to congestion or position, any tendency to obstruction becomes markedly accentuated. Especially is this the case during the second stage of induction, when a patient who has had apparently little or no difficulty in breathing up to that time becomes acutely cyanosed, and may require an immediate and hurried tracheotomy, and is exposed to all the risks which follow such an operation, carried out under these unfavourable circumstances.

When obstruction of a marked degree is present, tracheotomy is performed under local analgesia, and constitutes the first step in the treatment. The patient is sent back to bed for some days to become accustomed to this type of breathing, and to recover from any dyspnœa from which he may have been suffering.

When the obstruction is slight or absent, after a preliminary hypodermic of $\frac{1}{60}$ gr. of atropine, anæsthesia is induced with chloroform on an open Schimmelbusch mask with a small stream of oxygen playing under the mask the whole time. Chloroform is chosen as the agent least likely to increase any respiratory

embarrassment. When the third stage of anæsthesia is reached, a low tracheotomy is performed and a wide-bore tube inserted. This is by no means always a simple operation, especially when, as is not infrequently the case, the patient is of the short, thick-necked type.

Should some difficulty have occurred during the tracheotomy, and the patient have become cyanosed, or should a longer time than usual have been taken in performing this preliminary operation—as for instance, in a case I have in mind, in which there was a large thyroid which necessitated a partial thyroidectomy before the tracheotomy opening could be made—then the patient is sent back to bed and nothing further is done that day.

Lung complications following these operations are the most to be feared, and account for by far the largest proportion of fatalities which may follow this class of work. It is, therefore, necessary to consider every means of lessening the likelihood of their occurrence.

First and foremost is the question of sepsis: any steps that can be taken to lessen this will help to ward off the onset of pneumonia later.

In this connection the state of the patient's mouth and nose is of great importance. The condition of the teeth makes the first claim on one's attention. At first glance this may not appear to fall within the province of the anæsthetist, and strictly speaking it does not come within his jurisdiction, but considering the fact that any lung complication which may follow the operation may be considered by some surgeons to connote an error on the part of the anæsthetist, it certainly behoves us to take all possible steps to see that any such sepsis is cleared up. As you all probably know, Mr. Trotter holds strong views on the importance of this clearing up of dental sepsis, and nothing but the removal of every tooth will completely satisfy him. Exceptions to this rule he allows in cases when the subject is young and the removal of sound teeth would be a severe loss to him. But in the cases under consideration it is exceptional to have young subjects. A removal of obviously septic teeth, and scaling and general cleaning up of the remainder, even when "passed" by a competent dentist, does not constitute a satisfactory preparation of the mouth for these operations. There must be a complete removal of all remaining teeth and stumps, and the gums must be given ample time to heal up before the radical operation can be attempted with a reasonable chance of safety. In some cases a month may be required to allow of the healing and clearing up of the patient's mouth, and it is interesting to note the amelioration of the symptoms which may follow this elimination of oral sepsis; the glands of the neck, for instance, may become smaller and dysphagia lessen.

A second point in guarding against post-operative pneumonia is to prevent blood from being sucked or running down the trachea during the operation. This is why it is preferable to do a tracheotomy under the best conditions possible, without hurry, and with all bleeding points secured before the opening is made into the trachea. With a wide-bore tracheotomy tube once safely in position, it is possible to pack off the entrance of the larynx from above during the operation, and to change the packing as often as it may be necessary when it becomes soaked with blood. This is done frequently by the surgeon throughout the operation, and its importance is not overlooked even during the most exacting periods of the operation. Packs soaked in cocaine and adrenalin are also employed to render the mucous membranes analgesic, and they play a part in lessening the amount of general anæsthetic which is required.

For these operations it is preferable to have a tracheotomy opening rather than some kind of endotracheal tube passed down from above, not only as affording a safer method for complete packing off and so separating the field of operation from the trachea, but also because of the possible risk, when an endotracheal tube is passed, of carrying down infection, or of dislodging a portion of the growth, and

so disseminating the disease directly into the lungs. Again, the tracheotomy is superior to the endotracheal tube on account of the complete freedom of the field of operation afforded to the surgeon. A wide-bore endotracheal tube lying within the lumen of the pharynx takes up a considerable amount of room there, and in cases of pharyngeal growths necessitating a segment of the pharynx being dissected out, it gets in the surgeon's way. If a narrow-bore endotracheal catheter is used, the return air, whilst tending to keep blood out of the trachea, creates an obstruction to the clear view of the operation, by frothing and bubbling of the blood. And, finally, it is a necessity in the majority of these cases to retain a tracheotomy tube for some weeks after the operation, in order to maintain an unobstructed airway and to allow the wound to heal without mucus from the lungs passing over the raw surfaces.

Coming to the choice of the anæsthetic to be used in these cases, we prefer and always use chloroform—chloroform plus oxygen. I am aware of the prejudice that exists against chloroform at the present time, and I am emphatically against its indiscriminate use in the wrong type of case, but I submit that these are the right type of cases. I have Mr. Trotter's word for it that during the whole of the time he has been performing these operations, he has never had a moment's anxiety from the anæsthetic itself, and I can fully endorse his opinion from my own experience, lasting nearly twenty years, in this type of work. Provided plenty of oxygen is given at the same time, and a perfectly free airway is maintained, as it is bound to be when a tracheotomy tube is inserted, chloroform appears to be extremely suitable for these patients. During the operation the patient is noticeably free from any tendency to congestion and hæmorrhage, and at the end of operations lasting anything up to two hours it is usual for the patient to leave the table almost conscious, with coughing reflex present, and in an excellent condition, with the pulse very little, if any, faster than at the beginning. Vomiting afterwards is not infrequently absent, or of the mildest character, and in no instance have we had a case of delayed chloroform poisoning.

The actual method of giving the chloroform, once the tracheotomy tube is in place, consists of bubbling oxygen through chloroform in an ordinary Junker's bottle, looped on to the oxygen cylinder, and leading the oxygen and chloroform to the patient through a short rubber tube with a malleable end-piece hooked into the mouth of the tracheotomy tube. The modern reducing valve, such as the Adam, or Beard, for example, fitted to the oxygen cylinder, makes the task of regulating the amount of chloroform extremely simple. It is literally a "finger-tip" control. In addition, I have fitted to the Junker's bottle a Mennell's two-way cock, which enables one to deflect the oxygen to the patient without its passing through the chloroform, should one feel that the patient would be better with less chloroform, but requires the same amount of oxygen.

Very little chloroform is required to keep the patient just under, which is all that is necessary, and one is surprised, on measuring the amount used, that it comes approximately to not more than three or four drachms per hour.

The question of the part played by the anæsthetic itself in the production of pneumonia is a difficult one, and one on which there are divergent views. We hold that the action of chloroform given in this way, and in these small amounts, is practically negligible in its effect upon the lungs.

In this connection, if I may be allowed to digress for a moment, there come to my mind occasions, during the European war, when we were troubled with severe bronchitis and pneumonia following simple operations, such as hernia, done under ether or a mixture with chloroform. We performed a series of these operations under local infiltration with novocain, and I still vividly recall the fact that some of the worst cases of lung trouble followed the operations so performed when no inhalation anæsthesia was given, which certainly shows that in those cases at least the inhalation anæsthesia was not the cause of the chest complications. Some of the

earlier cases of lateral pharyngotomy were operated on under local infiltration with novocain and adrenalin, assisted by cocaine packs for the mucous membrane, by a colleague of mine, with a view to exploring the possibilities of this method, and no great difficulty was experienced in producing a satisfactory analgesia, especially in those cases where the glands were only slightly affected.

Exception to this method was however taken by the surgeon, on the following grounds: (1) The undesirability of infiltrating in cases of malignant disease in which recurrences are so prone to occur, as so little is known as to the mechanism of recurrences. (2) The extra strain imposed upon the patient, although I think this can be overcome now with so many pre-anæsthetic medications at our disposal. (3) The result obtained by this method gave no indication of improvement on the light chloroform-and-oxygen combination.

An interesting point, and one that appears to have escaped notice, is the change in the behaviour of the patient's respiration after a tracheotomy has been performed. The regular to-and-fro breathing of the normal individual is replaced by an entirely different type of respiration, long periods of apnœa being followed by periods of dyspnœa, and this may continue throughout the whole of the operation, but usually, as time goes on, these variations give place to a more normal type of breathing. Unless both the surgeon and the anæsthetist are familiar with this phenomenon some embarrassment may occur, and one has heard of cases in which the surgeon had great difficulty in restraining the anæsthetist from performing artificial respiration during the apnœic periods. This change in respiration has been attributed to the cutting out of part of the upper air-passages from the stimulus of contact with the respired air, and thus depriving the individual of the normal reflex to breathing. A change over to a chemical type of respiration results, depending upon the carbon dioxide in the circulation acting on the respiratory centre. If this is the true explanation, it is a little difficult to understand why a patient anæsthetized through a wide-bore endotracheal tube, allowing for to-and-fro breathing, does not exhibit the same phenomenon, as the upper air-passages are effectively cut off from the stimulus of the contact with respired air. The packing of the pharynx with cocaine and adrenalin, during the main part of the operation, whilst the patient is under chloroform, may lead to some comment. One has heard of the most alarming symptoms, and even death, resulting when this has been done. Up to the present time I have been fortunate in never experiencing any unfavourable symptoms, though, as the patients are undoubtedly under light chloroform anæsthesia, they should be in just the right condition to develop them. One laryngologist whom I approached on this subject suggested that the laryngeal mucosa absorbed cocaine and adrenalin more slowly than that, for instance, of the nose, and certainly in most of the cases of which I have heard the trouble occurred when adrenalin was placed in the nose whilst the patient was under chloroform anæsthesia. I have repeatedly seen both cocaine and adrenalin applied to the nose of patients under chloroform, and have always anxiously watched to see whether any untoward result would follow, but have never been able to detect the slightest change in the condition. Were it not for the well-authenticated cases reported from time to time, one would almost regard this danger as one of those myths that crop up in the realms of medicine.

In regard to premedication before these operations, as the majority of them were performed before the recent influx of new preparations, and as there are not a great number performed each year, I can say very little.

In the last two cases nembutal was given by the mouth before the operation, and the patients had the benefit of being asleep before the induction was begun, but apart from that, varied in no perceptible way from those who had not had nembutal. Neither of them, fortunately, showed the marked restlessness afterwards that is such a distressing feature in many cases of patients coming round after nembutal.

The régime which I have attempted to describe is that carried out in the majority of our cases, but as the operation itself is liable to variation to suit the

particular requirements of the patient, so also the method of giving the anæsthetic is subject to variation, and is not bound by hard-and-fast rules. For growths occurring on one or both cords, whether dealt with by a laryngo-fissure or a total laryngectomy, we carry out a similar routine: first a clearing up of oral sepsis, and then a preliminary tracheotomy, the anæsthetic being given through the tracheotomy tube during the operation.

For growths occurring higher up in the air-passages a different course is adopted, and one of the following two methods may be used for giving the anæsthetic. Either a preliminary laryngotomy is performed and the pharynx packed off from the larynx, the anæsthetic then being administered through the laryngotomy tube in the way already described, or else resort is made to endotracheal anæsthesia. The choice between performing a laryngotomy or having an endotracheal tube rests with the surgeon. The nearer the operative measures approach the upper opening of the larynx, the more danger there is of laryngeal obstruction developing afterwards.

It has been found that if in those cases in which the operation was just possible without an artificial opening into the larynx, obstruction should occur, and a tracheotomy have to be hastily performed (usually in the night following the operation), then these cases invariably did badly. If then there is a risk of laryngeal obstruction following the operation, we always perform laryngotomy, and the tube is left in for from twelve to twenty-four hours afterwards. Should the operation be of such a nature that an opening into the larynx is required for a longer period than this, a tracheotomy is performed and not a laryngotomy, as a laryngotomy tube becomes painful to the patient if left in for over twenty-four hours.

In the large group of cases in which the operation is well away from the opening of the larynx and there can be no danger of obstruction afterwards, one of the endotracheal methods presents the most satisfying way of giving the anæsthetic.

Personally, I prefer the anæsthetic vapour to be supplied under low pressure, through a wide-bore soft rubber endotracheal tube, which provides for a return airway, and allows the larynx to be packed off from the operation.

Of the two routes—the nasal or the oral—by which the tube may be passed, the nasal route presents many advantages. The tube lies well out of the way in those cases in which it is necessary to split the cheek or to divide the jaw to gain access to the growth.

Lately I have employed the technique described by Dr. I. Magill as the "blind intubation" method, through the nose, and have found it of great advantage in these cases, as it does away with the laryngoscope, and so obviates the possibility of damage to the growth by that instrument. I confess that I cannot always pass the tube through the nose directly into the larynx without the aid of the laryngoscope, but increasing familiarity with this method has reduced the frequency of this necessity.

To the free upper end of the tube I fasten a Rowbotham metal angle-piece. With this endotracheal tube in place in the larynx, and with the metal angle-piece fixed to its upper end, it is possible to give ether, gas, and oxygen with ether, or chloroform and oxygen, by simply connecting the delivery tube from the anæsthetic apparatus on to the metal angle-piece.

As the majority of major operations in the class of case we are considering are undertaken for some form of malignant disease, the patients are usually elderly, and again we have a preference for chloroform and oxygen. The patient's quiet and regular respiration and the absence of engorgement when under this anæsthetic are of great assistance to the surgeon, whilst the condition of the patient afterwards is extremely satisfactory.

Oxygen is bubbled through the chloroform as already described, and the tube from the Junker bottle is attached to the small tube of the Rowbotham angle-piece, and fastened by a piece of strapping, out of the way, as it passes over the patient's forehead. Control of the amount of chloroform is, of course, effected by the lever

on the reducing valve. This technique combines simplicity with the minimum amount of apparatus, and gives most satisfactory results.

In conclusion, turning back to the first group of cases—those in which the disease is situated in the hypopharynx or on the cords, and in which a tracheotomy is a necessary part of the operation and the after-treatment—I venture to suggest that it might be better for the patient if tracheotomy were performed in all cases, under local anæsthesia, and the patient allowed time to accustom himself to this type of breathing, and possibly to establish some degree of immunity, rather than that the preliminary tracheotomy and the radical operation should be performed on the same day. This step, in conjunction with the more rigid attention to oral sepsis, might, I submit, give an improved immediate prognosis.

Discussion.—Mr. LIONEL COLLEDGE said that the most important point was complete avoidance of respiratory obstruction. If obstruction was allowed to occur it was too late to perform tracheotomy as the damage was already done. Tracheotomy might restore the breathing, but there would be no quiet anæsthesia, and if a pulmonary complication followed it would be due not to the anæsthetic but to the respiratory obstruction which had been permitted to arise. When the entire larynx was to be removed it was useful to open the cricothyroid membrane at an early stage of the operation, insert a laryngotomy tube through which the anæsthetic could be given, and remove the tube with the larynx. In this way one got a clean wound.

Mr. I. W. MAGILL said that general anæsthesia was rarely necessary for tracheotomy and local anæsthesia was preferable. In one case in which general anæsthesia was demanded he had been confronted with some difficulty. The patient was suffering from tuberculous laryngitis and the operation had become a matter of urgency. Cyanosis and dyspnœa were considerable. Before attempting induction of anæsthesia oxygen was administered under positive pressure for several minutes, using a bag and face mask. The respiratory distress was relieved in this way to a remarkable extent. While maintaining the positive pressure, chloroform vapour was gradually added to the oxygen by means of a two-way stopcock. The induction was carried out with ease.

Chloroform was probably the most satisfactory anæsthetic for very robust or alcoholic patients. When chloroform was used, carbon dioxide should be available as with any other anæsthetic.

When practicable, he preferred nitrous oxide and oxygen, with suitable premedication, to chloroform alone. It was easy to administer this with a tracheotomy tube in position. In the case of patients suffering from malignant disease it seemed advantageous to use a less toxic agent than chloroform wherever possible. He agreed with Dr. Morris that surface application of cocaine was a valuable aid in throat operations. A light maintenance level was then easy to obtain and recovery correspondingly rapid.

With regard to restlessness following the administration of nembutal, he had found that this could be avoided in most cases by a suitable dose of omnopon and scopolamine one hour before operation. The quantity of nembutal subsequently required for basal hypnosis was then much less. The quantity to be detoxicated or eliminated was also less; this was important, as it was during the period of detoxication that restlessness was liable to occur. He had found, further, that the amnesic effect could be obtained with doses much smaller than would at first appear. In many cases, for example, investigation had shown that the required degree of amnesia had been reached before the response to questions had ceased.

For laryngectomy he was of the opinion that regional anæsthesia should be given preference in suitable subjects.

Section for the Study of Disease in Children.

President—Sir HENRY GAUVAIN, M.D.

[*February 26, 1932, continued.*]

Right Hemihypertrophy and Pubertas Præcox.—JOAN HARWOOD, L.R.C.P., M.R.C.S. (introduced by Mr. E. A. CROOK).

A. C., a boy, aged 6 years and 6 months.

History.—Fourth child, born at term, normal labour. Birth-weight 12½ lb. His mother thought then that he looked "one-sided," judging from his whole appearance rather than from the length of his right limb.

Brought up to hospital because of this at age of 6 months; record states that there was "hypertrophy of right limbs and right side of face; 1½ in. shortening of left leg." Photograph at age of two months shows marked difference between right and left arm and leg. Face not noticeably differing on the two sides.

Milestones: Teeth, ten months; walked, eighteen months; talked, eighteen months. Eighteen months ago parents noticed private parts were growing large for his age. Nothing unusual noticed about them till then. No illness since birth, except whooping-cough. No injury. Growth uniform on each side of body. Mental development and habits good, good report of both from school.

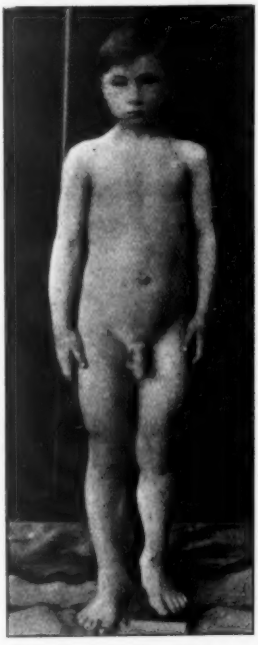


FIG. 1.

Family history.—Four children, three sisters, aged 11½, 9 and 8 years respectively. Normal children, examined personally. No miscarriages or stillbirths.

Father, nil. Paternal grandfather, one leg shorter than the other, ? side. Reliable details not yet available. Paternal uncles, nil. Mother, nil. Maternal grandfather, nil. Maternal and paternal grandmothers, nil.

Physical examination.—Sturdy looking child, looks rather older than age (fig. 1). Good colour. Height: Standing, 4 ft. 3 in.; sitting, 2 ft. 2¼ in. Weight, 4 st. 9 lb.

10 oz. Skin: normal texture, not pigmented, no nævi. Hair on scalp normal, no hair on face and no axillary or pubic hair. Muscular development and tone +. Voice normal for a child of his age.

Head: Circumference of skull, 20½ in. The left frontal, parietal and occipital protuberances feel, if anything, slightly larger than the right. Two halves of circumference measure the same.

Face: Right side appears to be a little bigger than left. Eyes, nostrils and mouth not noticeably different on the two sides. Ears: No difference. Teeth not unusual. Right side of tongue slightly bigger than left. Palate and throat normal Left

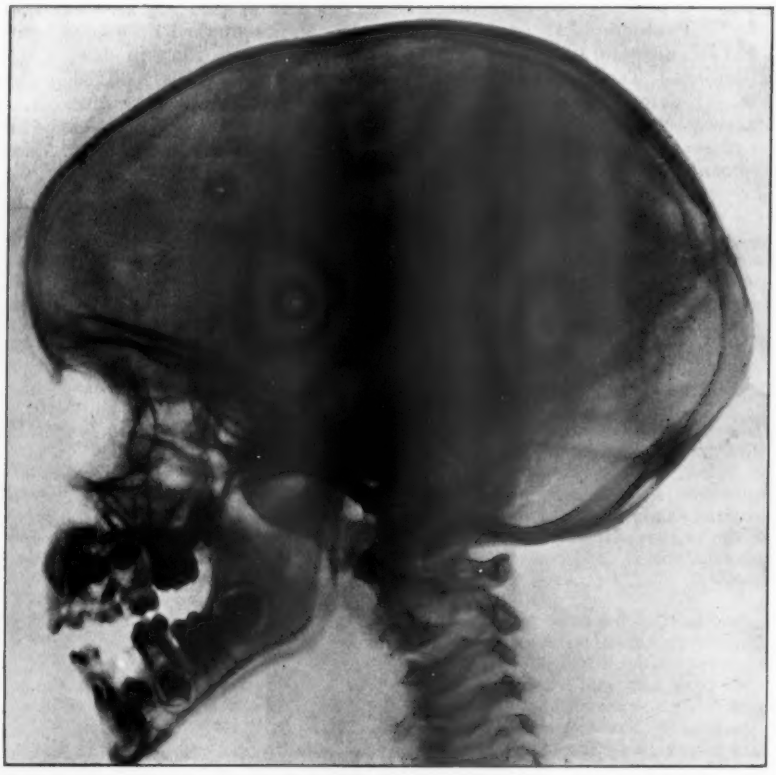


FIG. 2.

concomitant convergent strabismus alternating with right. Pupils equal and react to light and accommodation; optic discs normal.

Genitals: left testicle a little large for age, right larger; penis of a boy aged about 16 years; no pubic hair. Liver and spleen: Normal on percussion. Kidneys: Not palpated. Nothing abnormal felt per abdomen. Heart and lungs normal; blood-pressure 105/60; same on both sides. Urine: No sugar or albumin. Phosphates ++.

Skiagrams: Sella turcica—depth not increased, fossa continued upwards and forwards in a tongue-like manner beneath the anterior clinoid processes (fig. 2).

Posterior clinoid processes large. Skull large for age of child; no abnormality in bone. Right side of pelvis larger than left. Epiphyses: no difference on two sides (fig. 3). Structure of bone normal.

Renal skiagrams: negative.

Other Investigations.—Sugar tolerance, low. Optic fields, normal; no scotomata. Wassermann reaction, negative.

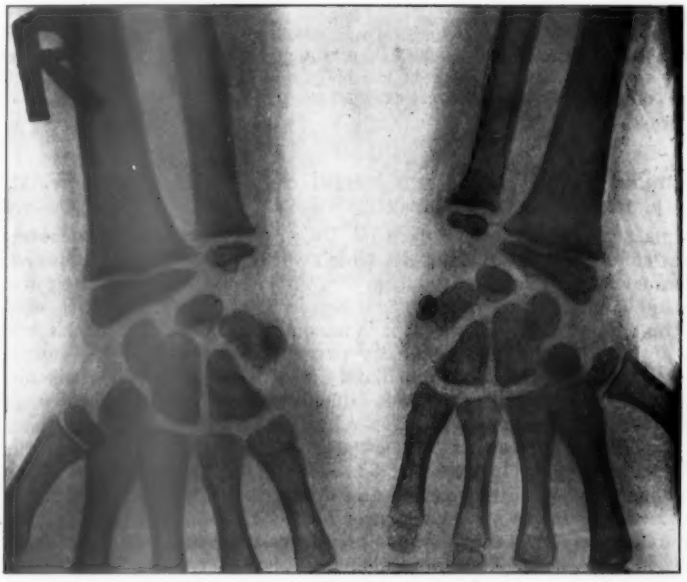


FIG. 3.

Subsequent examination, with the patient under anæsthetic, revealed a palpable tumour in the right loin, suggestive of a large kidney. The question now arises as to whether this is an enlarged kidney or a suprarenal tumour.

Discussion.—Dr. R. C. LIGHTWOOD said that hemihypertrophy had been reported in association with adrenal enlargement located on the same side of the body.[1] With this in mind, he had looked carefully for evidence of adrenal enlargement in the present case, especially as precocious puberty and genital hypertrophy were present, and he thought that a tumour could be felt in the loin in the position of the right adrenal body. Certain features of the case could be explained on the basis of over-secretion of the adrenal cortex and he advanced the view that enlargement of the adrenal body might either be the cause or a part of the hemihypertrophy—probably the latter. The possibility of operative removal of the adrenal tumour, if present, required careful consideration.

Dr. PARKES WEBER suggested that in this case, if there was hyperplasia or adenomatous neoplasm of the suprarenal cortex, the hemihypertrophy might perhaps be explained as an example of predominantly unilateral effect of the (generally distributed) hormone secreted into the circulating blood by the suprarenal cortical cells. Compare F. P. Weber: "Asymmetry or Unilateralism in General Disturbances of Growth," *Med. Press*, 1927,

1 Hutchison, R., *Brit. Journ. Child. Dis.*, London, 1904, i, 258.

clxxv, p. 244; also F. P. Weber and F. R. B. Atkinson, "Unilateral Cutis Verticis Gyrata," *Brit. Journ. Derm. & Syph.*, 1928, xl, p. 454.

Dr. HELEN MACKAY said she was interested to learn that Dr. Hutchison and the last speaker thought that a tumour was palpable in the region of the suprarenal. She had examined the abdomen for such a tumour but had not been able to feel it. It was of interest that, unlike a number of the cases of tumour of the suprarenal cortex described in the literature, there was in this boy no hirsuties. Apparently also there was no definite mental precocity. Dr. Harwood had, in conversation, discussed another possible view of the case, namely, that the right hemihypertrophy (which was known to have been present from birth) was the cause of the penile development. Dr. Harwood had described the right side of the body as now being several years "older" than the left. The right testis had shared in the hypertrophy involving the right side of the body, and it was possible that this premature enlargement of the testis was the direct cause of the premature development of the penis.

Trigeminal Nævus and Homolateral Pial Angioma.—R. W. B. ELLIS, M.D. (by permission of A. G. MAITLAND-JONES, M.D.).

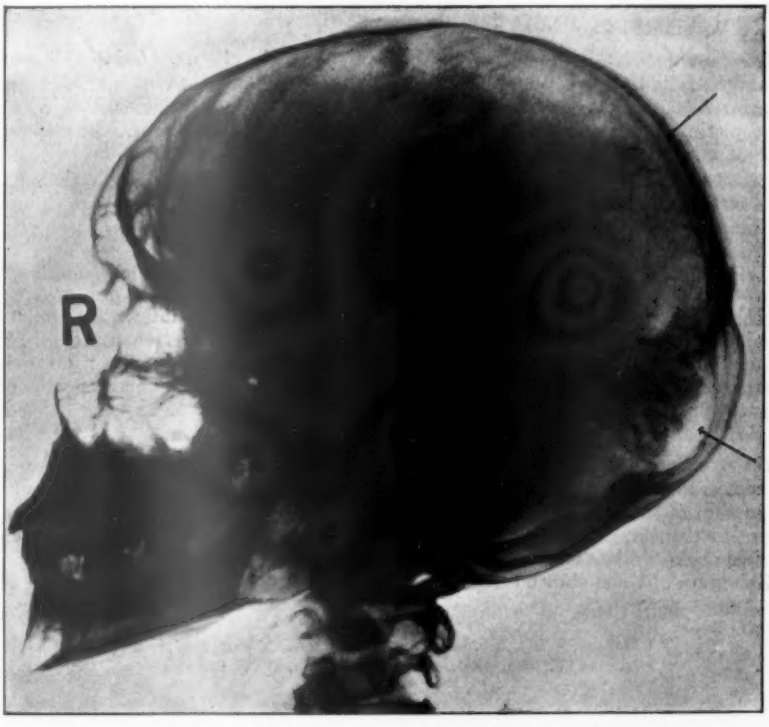
B. R., male, aged 9 years and 9 months. Only child. Since the age of seven months patient has suffered from recurrent fits which were frequent during infancy and have become less so recently (one only during past three months). The attack is described as consisting of shaking movements starting in the arms (? the left), and rapidly affecting the whole body. The patient is unconscious during the attack, which may occur during sleep; he has occasionally passed urine or bitten his tongue during attack, and afterwards he falls immediately into deep sleep. There is no definite aura. The mother complains that he is difficult and silly. He tends to drag the left leg, and frequently trips over. He was admitted to the National Hospital, Queen Square, in 1931, when operation was considered but was not proceeded with. Admitted to the London Hospital 17.1.32. No fits have occurred since this date.

On examination.—Mentally active and co-operative, but considerably backward for his age. An extensive nævus in approximately the cutaneous distribution of the ophthalmic division of the fifth nerve is present on the right side of the face. There is slight left lower facial weakness, and slight weakness of the left grip (fig. 1). The uvula deviates to the right. There is a left external strabismus. Knee- and arm-jerks equal, ankle-jerks not elicited, abdominal reflexes present, right plantar reflex flexor, left equivocal; ? very slight ataxia of both upper limbs. Liver and spleen not papable. Visual acuity, right $\frac{6}{12}$; left $\frac{6}{12}$; left homonymous hemianopia; retina healthy; discs normal. Wassermann reaction negative. Urine normal.

X-ray report (Dr. Jupe).—"Stereoscopic films of skull show two racemose areas of calcification, consisting of parallel linear shadows. The lower area is situated above the level of the tentorium cerebelli and on the right side of the skull, roughly following the right occipito-parietal suture above (fig. 2). There appears to be some slight general opacity in the whole of this region. The upper area is small and lies in the region of the posterior part of the right parietal bone. The appearance would be consistent with calcification taking place in an angioma, and this is supported by the fact that the parallel linear shadows probably represent the structure dipping down into the sulci."

This case illustrates the clinical syndrome of Jacksonian epileptic attacks associated with a trigeminal nævus (here affecting the cutaneous distribution of the ophthalmic division only). The symptoms and restriction of visual fields are accounted for by the presence within the skull of an angioma which (as in many of the reported cases) appears to be entirely above the tentorium, and on the same side as the nævus. It is, perhaps, exceptionally early for such extensive calcification to have taken place in the vessel walls, but three closely similar cases have recently

B. R.: Trigeminal nævus (cutaneous distribution of the ophthalmic division of the right fifth nerve).



B. R.: Skull showing calcified angiomata in the right occipital and parietal areas.

been reported in children by Marque[1] and Dimitri.[2] Operation has not been attempted owing to the fact that these angiomata usually extend deeply into the brain substance, and removal has not generally been found practicable.

Dr. PARKES WEBER said that the somewhat "festooned" shadowing in the radiogram of the head in Dr. Ellis's case was pathognomonic of the presence of localized leptomeningeal hæmangiectasis of congenital-developmental origin. The shadowing was of course due to local calcareous deposition, which had not yet taken place in the infant shown by Dr. Rocke and Dr. Mackay. (On the other hand that infant had the very important sign of unilateral buphthalmos.) Dr. Weber did not think that in this rare class of cases hæmorrhage usually occurred into the cerebrospinal fluid in connection with convulsive seizures, unless it was noted that permanent hemiplegia followed the convulsions or that existing hemiplegia (hemiparesis) became aggravated.

Two Cases of Congenital Œdema.—R. W. B. ELLIS, M.D. (by permission of A. G. MAITLAND-JONES, M.D.).

(I) S.S., female, aged 5 months. Parents and two older children alive and well. No miscarriages or stillbirths. Normal labour. Infant weighed 6 lb. at birth (full term), and showed at this time gross œdema affecting particularly the hands and feet (which were said to have "looked like balloons") and the face and neck; the œdema has gradually subsided, and, apart from marked pallor and slow gain in weight, the infant has appeared well. She was breast fed for two weeks, subsequently being given Grade A milk, water, and sugar formula. She has attended hospital since 2½ months of age, since when there has been little change in the physical signs. Vaccinated two weeks ago.

On examination: Pale, female infant, weight 11 lb. 12 oz. Cries and suckles normally. The hair is coarse and sparse. There are redundant folds of skin on the posterior aspect of the neck (said to have been distended with œdema at birth), and slight pitting œdema of the vulva and the dorsum of either foot. The spleen is enlarged two finger-breadths below the costal margin.

Blood-count (2.12.31): R.B.C. 3,600,000; Hb. 44%; C.I. 0·61; W.B.C. 5,000. *Differential*: Polys. 25%; eosinos. 5%; small lymphos. 64·5%; large lymphos. 7%; large hyal. 3%. Very slight poikilocytosis and anisocytosis.

Wassermann reaction of mother, negative.

Urine (16.2.32): Reaction acid, no albumin, cells or casts, Fehling negative.

(II) W. J., male, aged 5 months. Parents and one older child alive and well. No miscarriages or stillbirths. Full term; normal delivery, birth weight 6 lb. 7 oz. Artificially fed. At birth both feet appeared considerably swollen; no œdema elsewhere. The infant was first seen at 1 month of age when marked œdema of both was present. This has varied in degree since that time, but has never been completely absent. General health and activity has been normal.

On examination: Healthy-looking male infant, weight 11 lb. 4 oz. Cries, suckles, and moves limbs normally. There is pitting œdema of both feet, more marked over the dorsum of the left. The calf muscles feel somewhat firmer than normal, but the skin and subcutaneous tissue are unaffected. The spleen is not enlarged. No other physical signs of disease.

Skiagram of tibiæ showed nothing abnormal.

[1] Marque, A. M., *Rev. Oto-Neuro.-Oftal. y Cir. Neur.*, 1927, i, 202.
[2] Dimitri, V., *Rev. Assoc. Med. Argent.* 1923, xxxvi, 63.

Blood-count (16.2.32): R.B.C. 6,000,000; Hb. 80%; C.I. 0·67; W.B.C. 8,640. *Differential*: Polys. 32·5%; eosinos. 1%; small lymphos. 35·5%; large lymphos. 24·5%; large hyal. 6·5%.

Urine (16.2.32): Acid, no albumin, cells or casts. Fehling negative.

These cases are shown together by way of contrast, and appear to be of quite different type. The first shows splenomegaly, marked anæmia, redundant folds of loose skin around the neck (? a congenital malformation), and what was, at birth, generalized œdema. It is suggested that this is possibly a non-fatal case of hydrops fœtalis universalis, although there is (at five months of age) an absence of erythroblastosis. The cases of hydrops in which erythroblastosis has been described as characteristic, however, were all examined within the first few days of life, and it will be seen that here a severe anæmia persists.

The second case, on the other hand, shows simply œdema limited to the feet in an otherwise normal infant.

Dr. PARKES WEBER thought that the absence of erythroblastosis in blood-counts prevented one from regarding either of the two cases as a "forme fruste" of congenital universal hydrops. In both cases it remained to be seen whether the remaining œdema in the lower limbs would turn out to be of the Milroy-Nonne type.

Specimen: The Stomach of an Infant Twenty-nine Weeks after Operation for Hypertrophic Stenosis of the Pylorus (Rammstedt).—T. PEARSE WILLIAMS, M.D.

J. W., female, aged 6 weeks, was admitted to Paddington Green Children's Hospital 3.7.31, showing the clinical picture of a stenosed pylorus.

Operation 8.7.31 (Mr. V. H. Ellis).—Convalescence uneventful. The infant did well until November last when she developed a pneumonia.

1.1.1932. Developed persistent vomiting with constipation and was admitted to hospital again on 9.1.32. Signs of meningitis were present, and lumbar puncture showed a turbid fluid with a few intracellular meningococci. Death occurred on 30.1.32.

This infant was thirty-six weeks old at death and the stomach is shown to demonstrate the marked hypertrophy of the pylorus which is still present. The portion of muscle at the duodenal junction was almost cartilaginous in consistence and the junction is sharply demarcated.

Specimen: A Teratoid Tumour Successfully Removed from the Belly of an Infant.—T. PEARSE WILLIAMS, M.D.

M. R., female, aged 7 months, was admitted to Paddington Green Children's Hospital 27.6.30. The mother had noted a gradually increasing enlargement of the abdomen over the previous five months. Birth had been natural, and birth-weight was 8¾ lb. No special symptoms had been noted and the body functions were normal. Weight on admission was 16½ lb.

The infant was a happy, healthy-looking infant, taking her food well and showing no abnormal features except for occasional spasms of colic and the presence of a large mass in the right loin, irregular in form and consistence. The patient was transferred to the Willesden General Hospital, as the Children's Hospital was about to be closed for a short period. The general opinion was that the tumour was renal in origin and was probably a sarcoma.

Operation 18.7.30 (Mr. Mower White).—A long right paramedian incision was made and a large pale tumour presented. The surface was attached in places to the parietal peritoneum; about 4 oz. of turbid fluid escaped from the capsule. The

adherent small and large gut were easily separated and the whole mass was removed. A pedicle was ligatured and cut; there was only one large blood-vessel seen. The liver was seen to be normal, but owing to the severity of the operation no time was lost in getting the infant back to the ward. The right kidney and ovary were not definitely seen or felt. After the first twenty-four hours of anxiety convalescence proceeded without incident.

The weight of the tumour was $2\frac{1}{2}$ lb.—i.e., 15% of the body weight. Future progress has so far been uneventful and when seen recently the child was up to the normal average in weight and development.

Clinical Section.

President—Mr. CECIL P. G. WAKELEY, F.R.C.S.

[*March* 11, 1932.]

Right Temporal Meningocele in an Infant.—CECIL P. G. WAKELEY, F.R.C.S.

David H., aged 1 year and 5 months, born with large swelling just above and behind right auricle. This disappears on pressure and fills gradually; it becomes very tense when the child cries. It is translucent.

Lateral skiagram of skull showed slight defect in temporo-parietal suture. Child has been under constant supervision since age of ten months; swelling is gradually diminishing in size as the bony defect becomes filled in. There can be no doubt that a natural cure will result.

Spina Bifida Occulta with Hypertrichosis.—J. F. HALLS DALLY, M.D.

M. G., a girl, aged 10 years and 9 months.

Previous history.—Only child. Full term; difficult instrumental delivery. Always delicate and subject to catarrh and sore throats, with rises of temperature. Easily becomes overheated and perspires profusely. Pains in shoulders and arms. Aching in loins and lower limbs at times, and "pins and needles" after sitting in one position for long. Tonsils and adenoids removed in 1929.

Present condition.—Tall and well developed for her age. Fresh complexion. Texture of skin fine, elasticity good. Height 5 ft. 2 in. Weight 7 st. 9 lb. Gums show marginal sepsis; enamel of upper incisor teeth deficient over lower third which presents ridge-like lines. Cervical glands slightly enlarged. Arterial pressure 126/68, pulse-rate 68. Heart: Apex beat in fifth left space, 7 cm. from median line; right border 3·5 cm. from median line. Sounds normal, except for localized pulmonary cardio-inspiratory murmur when recumbent.

The condition for which the case is shown was discovered incidentally on the child's first attendance at the St. Marylebone Children's Rheumatism Supervisory Centre. Over the first sacral vertebra there is a depression of the skin from which springs, in an arc of a circle with convexity upwards, a flat band of hair, 8 in. in length, resembling a tail (fig. 1).

Report of X-ray examination of lumbo-sacral spine (Dr. J. E. A. Lynham).—The condition is one of spina bifida, the spinal canal being widely open in respect of the first sacral vertebra, the neural arch of which is absent, while that of the second is apparently incomplete. The spine of the last lumbar vertebra is divided into two (fig. 2).

Comments.—Our knowledge of spina bifida occulta dates from 1875 when, at a meeting of the Berlin Anthropological Society, Ornstein showed a photograph of a young recruit with hypertrichosis in the sacral region. At the same sitting Virchow[1] first described the condition. Until 1910 only 85 cases had been recorded, but of late years the number in the literature has notably increased, many coming from French and Italian sources. I believe it to be more frequent than is generally supposed, cases without symptoms or external evidences being found only by chance.

Developmentally, the various forms of spina bifida portray different stages of incomplete closure of the central canal of the spinal cord, whose lower end at birth reaches as far as the third lumbar vertebra. In the adult the cord ends at the first

[1] *Ztschr. f. Ethnol.*, 1875, Bd. 7, S. 279.

FIG. 1.

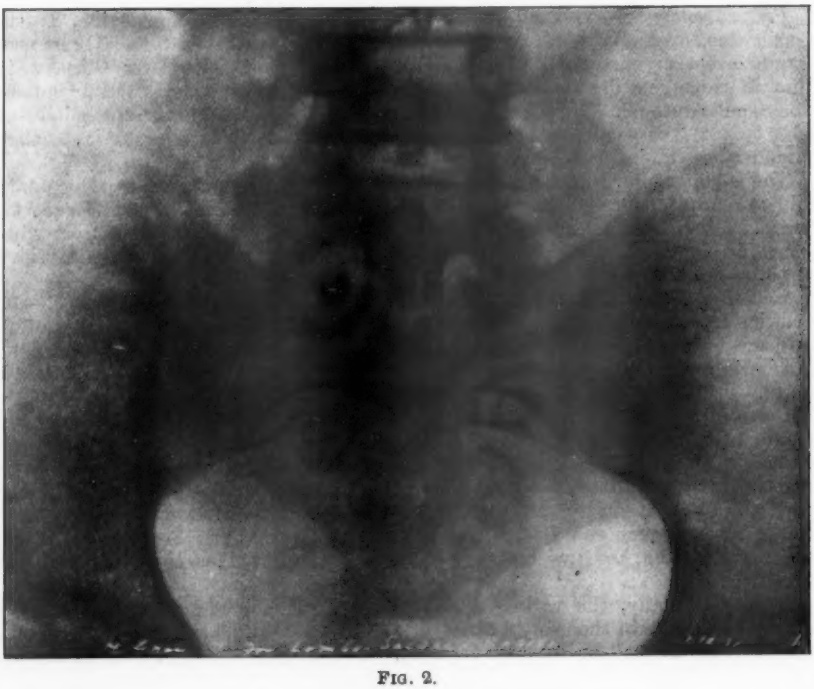


FIG. 2.

lumbar vertebra. Since the spine is said to grow faster than the cord, the symptoms of traction on lower nerve roots sometimes found in these cases may possibly be thus explained. More probably traction effects are due to definite fibrous tissue bands. Instead of dimpling or depression of the skin, tumours, often lipomata or myxomata, may be present. The most frequent and important symptom is loss of sphincter control, incontinence being either congenital or in adolescent or adult life. There may be muscular weakness of the lower extremities, from flat foot up to actual deformities, such as club foot. Nervous disorders of various grades are not infrequent. Symptoms vary according to the site of the defect, which is usually lumbo-sacral, sometimes cervical, and rarely thoracic.

Dr. HALLS DALLY (in reply to a Member) said: Because hair is a tissue of epiblastic origin, its abnormal site in certain developmental residues is thus explicable, as in the interior of dermoid cysts. In the present case the primitive medullary groove (epiblastic) has failed to close at the point where hypertrichosis is present. The growth of hair is most frequently median and lumbar in position, though rarely it may occur at higher levels, usually corresponding with the spinal defect, and may not necessarily even be median. In some cases the hairiness is congenital; in others it appears at puberty. (In reply to another speaker): The ridging of the lower third of the upper incisor teeth and deficiency of enamel was noticed by the mother at the age of 6, after whooping-cough, but I agree in regarding the condition as a prenatal defect in development, though of later origin than the spinal defect.

Two Cases of Essential Purpura Hæmorrhagica Six Years after Splenectomy.—BERNARD MYERS, C.M.G., M.D.

Each of these patients has been shown before the Section previously: Winifred B., 11.12.25 (*Proceedings*, xix, 31), and Mrs. E. D. on 8.11.26 (*Proceedings*, xix, 37).

Both suffered severely from hæmorrhages which endangered their lives.

The bleeding time of W. B. was twenty minutes before splenectomy, and E. D. fifteen minutes. The capillary resistance test was markedly positive in each. The platelet count in W. B. showed platelets almost absent, and in E. D. 60,000 per c.mm. on one occasion, but fewer on other occasions.

Each of them had splenectomy performed over six years ago, and has remained in perfect health since, without any sign of purpura hæmorrhagica or simplex. At present the bleeding time is normal (three minutes) in both, and the capillary resistance test negative.

Mrs. E. D. is now aged 35, and Winifred B. aged 17.

The blood-counts on 23.2.32 were:—

		E. D.	W. B.
R.B.C.	...	4,200,000	4,400,000
Hb.	...	81%	80%
C.I.	...	0·9	0·9
W.B.C.	...	8,000	6,500
Polys.	...	68%	63%
Eosinos.	...	2%	2%
Basos.	...	0·5%	1%
L. hyal.	...	6·5%	8%
Lymphos.	...	23%	26%
Platelets	...	130,000	185,000 per c.mm.

Reds—no significant abnormality; rather pale.

There appears to be no doubt of the marked benefit conferred on both these patients by splenectomy.

Dr. PARKES WEBER said he was inclined to agree with Dr. Bernard Myers that the good results of splenectomy in some cases of essential purpura hæmorrhagica might be explained most readily on the supposition that in such cases the spleen before its removal had been producing some toxic substance which gave rise to the purpura and hæmorrhages. On the other hand, Dr. Weber believed that in cases of familial hæmolytic jaundice splenectomy was effectual because there had been "hypersplenism"—that is to say, the

spleen had been exceeding its optimum hæmolytic action, by destroying too many of the erythrocytes (especially those which from their birth in the bone-marrow had been rather too "fragile"). In fact, the spleen in cases of familial hæmolytic jaundice was abnormal in the quantity of work that it was doing, whilst the spleen in essential purpura hæmorrhagica was abnormal in the quality of its work. This theory would explain why the spleen was so often not greatly enlarged in the latter disease, its injurious effects being due rather to a "perversion" than to an excess ("hypersplenism") of its functional activity.

Familial Acholuric Jaundice, without increased Fragility of Red Cells.—TERENCE EAST, D.M.

Miss D. S., aged 29.

Past history.—Jaundice all her life, variable in intensity. For some years pain over gall-bladder. Typhoid fever at age of 23.

Family history.—Paternal grandfather always jaundiced; father alive and well, aged 60; always jaundiced; sister has a trace of jaundice.

Brother, aged 12, had obscure febrile illness in 1931 in hospital, under the care of Dr. J. Livingstone. Jaundice was present.

Observations.—Blood:

		R.B.C.		Hb.		
1928	...	3·5 million	...	70%	...	Fragility R.B.C. normal to saline.
1932	...	3·06 million	...	75%	...	Reticulocytes 12·4%

Fragility R.B.C. normal to saline, on several occasions. Van den Bergh: 8 units, indirect, 19.1.32; 1·9 units, indirect, 2.3.32.

Urine.—No urobilin, no bile pigments or salts. Spleen never felt.

Cholecystectomy 3.2.32 (Mr. A. Edmunds).—A thickened gall-bladder removed, showing microscopically changes of chronic inflammation. No stones or pigment deposit. Culture of contents enterococci. Liver showed area of superficial thickening near gall-bladder. Spleen not enlarged. Probably subacute cholecystitis after typhoid.

R. S. (brother), aged 11, 1931. Liver and spleen enlarged. R.B.C. 2-3 million. Hb. 45—80%. Van den Bergh 1·6 to 2·85 units—indirect reaction. Fragility red cells, normal.

S. S. (sister). Blood-count, normal. Van den Bergh reaction: increase of delayed reaction pigment. Fragility of red cells normal.

Comments.—A family of which five members have shown jaundice persistently. Observations on three members show that the jaundice is of hæmolytic type, and acholuric. In three members the fragility of the red cells is normal.

There is a tendency to secondary anæmia, reticulocytosis and splenic enlargement.

Dr. E. ff. Creed kindly made the fragility observations.

Elephantiasis Treated by Kondoleon's Operation.—A. J. WATSON, F.R.C.S.

L. B., female, aged 54.

History.—Twenty-five years' gradual swelling of the right leg following erysipelas of the thigh during pregnancy. Has had recurrent attacks of erysipelas.

Admitted to hospital under Mr. Sampson Handley, December, 1931.

Condition on examination.—Advanced elephantiasis of the right leg with redundant skin and subcutaneous tissue (fig. 1); slight pitting on pressure. Skin showed many warty elevations. Unable to walk or wear a shoe. Left leg, very slight enlargement. Limb reduced in size during rest in bed.

January 8, 1932.—Modified Kondoleon's operation by Mr. Sampson Handley. Owing to very profuse hæmorrhage the femoral artery was also ligatured in Hunter's canal. Leg decreased remarkably in size (fig. 2).

FIG. 1.—Before operation, 15.12.32.

FIG. 2.—After Kondoleon's operation, 22.2.32.

January 26, 1932.—Two redundant folds of skin excised. Leg further decreased in size.

February 22, 1932.—Patient discharged from hospital walking easily and wearing a special supporting boot.

Erythræmia or Erythro-leukæmia.—F. PARKES WEBER, M.D.

The patient (Mrs. R. B.), aged 52½, Russian Jewess, has splenomegalic polycythæmia (erythræmia, the Vaquez-Osler syndrome), the symptoms of which commenced apparently a year or so after her menopause, which was in 1924. She has sometimes had slight psoriasis, which, I believe, is not unusual in erythræmic patients. On November 15, 1929, the blood-count gave: Hæmoglobin 140%; erythrocytes 9,500,000; leucocytes 17,800 (eosinophils 2%; myelocytes 2%; metamyelocytes 5%; polymorphonuclear neutrophils 68%; lymphocytes 20%; monocytes 3%); the erythrocytes appeared normal; one nucleated red cell (normoblast) was counted to 100 leucocytes. The urine was free from albumin, sugar, and excess of urobilinogen. Brachial blood-pressure: 140/80 mm. Hg. Roentgen-ray examination of the thorax showed nothing abnormal. About that time the lower edge of both the spleen and liver were at the umbilical level. No enlargement of superficial lymph-glands. No clubbing of fingers or toes. Negative Wassermann reaction.

Since then the treatment has been chiefly by cautious courses of phenylhydrazin chloride (0·1 gramme, mostly once daily, for two or three weeks), but also occasional blood-letting. *At present* (February 27, 1932, after phenylhydrazin chloride, 0·1 gramme, once daily, for two weeks) her blood-count gives: Hæmoglobin 92%; erythrocytes 5,920,000; leucocytes 23,600 (basophils 1%; eosinophils 2%; metamyelocytes 5%; polymorphonuclear neutrophils 76%; lymphocytes 11%; monocytes 5%); some polychromasia and slight anisocytosis, but no poikilocytosis; no nucleated red cells seen. The Hijmans van den Bergh reaction is negative direct, and fairly strongly positive indirect. The urine is free from any excess of urobilin or urobilinogen. The lower edge of the spleen is at the anterior superior iliac spine, and the liver reaches two finger-breadths below the costal margin in the right nipple line. Brachial blood-pressure: 130/75 mm. Hg. No jaundice.

One sister of the patient is a plethoric-looking married woman at about the climacteric period, but has not yet developed any certain signs of erythræmia. The blood-counts in the patient herself suggest that the case is one in the "erythro-leukæmic chain" (F. P. Weber, *Med. Press*, 1929, clxxix, 475), but very close to typical erythræmia. The thrombocyte-count was in excess (970,000) when taken on April 15, 1931. Blood-serum cholesterol (March 2, 1932): 232 mg. per cent. No abnormal "fragility" of the erythrocytes (October 26, 1931). There is no achlorhydria, as there was in the last erythræmic case (F. P. Weber, *Proc. Roy. Soc. Med., Clinical Section*, xxv, 10). Whilst under observation the sclerotics have had occasionally an icteric tinge, sometimes certainly in connection with the phenylhydrazin therapy.

Discussion.—Dr. E. STOLKIND said that a diagnosis of erythræmia could frequently be made in the stage at which the number of red blood-cells was only about 6,000,000. For instance, at the Meeting of the Section held in March, 1931,[1] he showed the case of a man who had 6,380,000 R.B.C. That patient now had a blood-count of 7·9 million red cells and 27,000 white cells (previously there were 15,700 white cells) and the spleen was more enlarged. The female patient shown on that occasion had died a few days ago from a gastric hæmorrhage.

Blood-letting often relieved subjective symptoms but its effect was not lasting; in some of his (the speaker's) cases the number of red cells had increased again shortly after venesection. He treated his cases of erythræmia with X-rays; he also now treated them with phenylhydrazine, but before administration of this dangerous drug, the tolerance of the

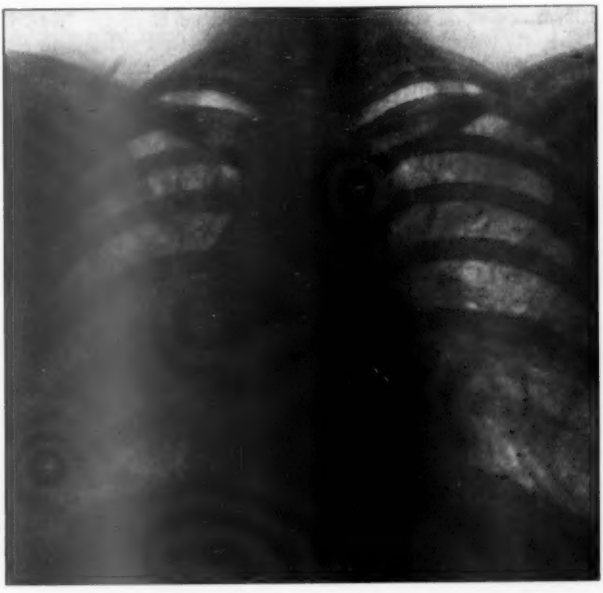
[1] *Proceedings*, 1931, xxiv, 925 (Clin. Sect., 93).

patient to it should be carefully investigated, as it had a cumulative effect lasting for more than two weeks. As a rule he gave his out-patients only six capsules, each of half a grain of phenylhydrazine hydrochloride, two capsules to be taken in a week.

Dr. EAST said that the leucocytosis in the second blood-count might be due to the effect of the phenylhydrazine on the liver: such increase in the white cells was not uncommon. He agreed that phenylhydrazine was a dangerous drug, and one likely to cause damage. The effects could not easily be controlled, and were liable to be cumulative, so that the red cells went on decreasing after administration of the drug had ceased.

? Diffuse Pulmonary Fibrosis.—F. PARKES WEBER, M.D., and O. B. BODE, M.D.

The patient (Mrs. J. M.), aged 37, is a well-developed woman, of medium general nutrition, who for the last two years has complained of shortness of breath on exertion and a troublesome "dry" cough. Roentgen skiagrams (October, 1931, and February, 1932) show diffuse sclerotic changes in both lungs, best marked in the middle portion of the right lung. The movement of the diaphragm on both sides is



? Diffuse pulmonary fibrosis. Skiagram taken on February 27, 1932.

deficient. Sputum can be obtained only with difficulty, and is clear and apparently free from tubercle bacilli and yeast-like organisms. Wassermann and Pirquet reactions, negative. Erythrocyte sedimentation, not unduly rapid. Examination of blood and urine and general examination show nothing abnormal, excepting as above stated. Patient's father and mother are both living, aged 73 and 72 respectively, and her four brothers and sisters are all living and well. She has had one child (a boy, now aged 18 years, living and healthy), and one miscarriage. Seventeen years ago she had an operation of some kind in the lower part of the abdomen. There is no

history pointing to the excessive inhalation of asbestos or other dust. The possibility of a secondary slowly and diffusely infiltrating neoplasm of the lungs cannot be absolutely excluded, *e.g.*, such as that in the case reported by Barnes, Thomson and Lamb, *Quart. Journ. Med.*, 1926, xix, p. 151.

Sclerodermia and Myasthenia Gravis.—F. PARKES WEBER, M.D., and O. B. BODE, M.D.

The patient (Mrs. A. B.), aged 51½, a somewhat thin woman, has symmetrical sclerodactylia of the hands, of moderate degree, which commenced apparently during the latter part of 1929, and as usual in such cases has been associated with typical angiospastic Raynaud-like phenomena—fingers turning white or "going dead" and then becoming blue. For a rather shorter time she has had superficial sclerodermia of the upper part of the body, involving especially the clavicular regions, the neck, and (to a lesser extent) the face.

Besides this, patient has symptoms of myasthenia gravis, which have gradually appeared since the latter part of 1931: Slight bilateral ptosis (i.e., tendency to drooping of the upper eyelids especially when patient is tired in the evening); great weakness in the muscles of the back of the neck, so that her head tends to sink forward, and she often pushes her chin upwards with her hand in order to extend her neck; during a meal she gets fatigue in swallowing, though not in masticating; rapid fatigue on walking or any ordinary muscular exertion.

Otherwise general examination of the viscera, urine, blood and gastric contents shows nothing abnormal. The thyroid gland is felt of moderate size. The blood-serum gives negative Wassermann and Meinicke reactions. Brachial blood-pressure, 145/90 mm. Hg. Roentgen-ray examination of the hands shows very slight absorption in the terminal phalanges. The "myasthenic reaction" has not been examined for in the trapezius muscles. There is no reaction of degeneration. Apart from the above troubles the patient has enjoyed good health. Menopause in September, 1930. She has had three children (all living) and one miscarriage.

"Rheumatic" Episcleritis and Arthritis.—D. C. HARE, C.B.E., M.D.; C. B. HEALD, C.B.E., M.D.; and IDA MANN, F.R.C.S.

Mrs. E. B., aged 50, in February, 1928, had an attack of Bell's facial palsy. At about the same date arthritis began in the right wrist and has persisted ever since. At first there was only pain, but swelling and stiffness gradually developed, and in April, 1931, she had to give up her work on account of the disability. At the beginning of July, 1931, she came under treatment, the arthritis being still strictly limited to the one wrist; the tonsils were found to be infected, and on July 17 were treated by diathermy puncture. This was followed within a fortnight by general joint pains; ankles, knees, elbows, shoulders and small joints of the hands became involved, and six weeks later patient had to go about in a chair. Towards the end of September an episcleritis of the right eye developed; the left eye became similarly affected eight weeks later. She was admitted to the Royal Free Hospital on December 17.

On admission.—She had lost one stone in weight since the onset of the illness; the skin was moist, the pulse-rate raised, average rate 90; there was no fever. *The joints* chiefly affected were the elbows and wrists, the proximal interphalangeal joints showed spindle-shaped deformity, the ankles and knees were less affected. *The tonsils* were large and septic, no sinus or ear infection was found. No evidence of disease elsewhere was detected.

Note on the eye condition [Ida Mann].—When first seen on October 17 there were about three nodules of episcleritis on each eye. There was no discharge and no intraocular involvement. The nodules gradually became confluent and the whole

sclera, except a small part above in each eye, became involved and intensely injected. After five months a purplish congestion still remains. The condition is a "rheumatic" episcleritis which is unusually resistant.

Investigations.—Skiagram shows disorganization of bone and destruction of cartilage in both wrists. Test meal.—Resting juice foul, no free hydrochloric acid, lactic acid present in all fractions. Wassermann reaction negative.

Treatment of the joint condition by C. B. Heald has included paraffin-wax baths, sunlight and diathermy; sodium salicylate was given in large doses. The general condition and the arthritis have improved, and there has been a steady gain of weight.

Dr. PARKES WEBER said he supposed that the episcleritis was a reaction analogous to "rheumatic" fibrositic troubles elsewhere, but all such reactions might possibly be of the nature of *allergic* reactions, resulting from hypersensitization towards toxins which in ordinary persons might be present without interfering with apparent health.

Arteriovenous Aneurysm of the Hand in a Child.—GERALDINE BARRY, M.S., F.R.C.S.

Eleanor L., aged 12 years. Eighteen months' history of painless swelling of the left hand. Indefinite history of ? injury to the hand in a street accident at age of 2 years.

On examination.—Expansile swelling in the left hand between the second and third metacarpals, occupying distal half of the interosseous space, with pulsation transmitted both on dorsal and palmar surfaces.

Many dilated veins over outer half of hand; in a specially large one on dorsum of hand distinct arterial thrill can be felt. The swelling is hot to the touch, and there is separation of heads of metacarpals (confirmed by skiagram).

Aneurysm supplied mainly by radial artery; on compression of this at wrist only very slight pulsation in swelling is left and this disappears on compression of ulnar artery at the same time.

Question of treatment.—It is suggested that ligation of the radial artery at the wrist will cut off most of the blood-supply to the aneurysm, and that this should be done as a preliminary operation; direct interference with the aneurysm being postponed until the effect of the first operation is observed.

Dr. EAST drew attention to the difference in the pulses. That in the left wrist was distinctly collapsing, and so was in keeping with the diagnosis of arteriovenous aneurysm, which was in fact a leak in the arterial circulation.

Adrenal Neurocytoma with Cranial Metastases (Hutchison's Type of Suprarenal Sarcoma).—REGINALD LIGHTWOOD, M.D. (by permission of F. J. POYNTON, M.D.).

B. H., aged 3 years and 5 months; an only child. Past history uneventful until August, 1931, when he complained of abdominal pain intermittently for one month. Admitted to Ealing Hospital, where hips and abdomen were examined by X-rays, but nothing abnormal was detected. In November, 1931, knees, elbows and back became stiff and painful; patient was only able to walk with difficulty but after a time improvement set in. In the last week of January, 1931, tender swellings appeared on the head and these have been increasing in size during the last five weeks. Glands in neck began to enlarge about same time.

On examination.—Pale, sallow boy. Skull: Small secondary deposits can be felt as thickenings of membrane bones. Secondary deposit seen to have involved right orbit and right eye is displaced downwards, forwards and inwards. Another deposit is seen over anterior part of the left temporal bone. Veins visible on both sides of forehead. Lymphatic glands: enlarged in inguinal regions, Scarpa's triangles,

axillæ and both sides of neck. Thorax: no evidence of metastases. Hæmic cardiac bruits at apex and base. Abdomen: No primary suprarenal mass definitely located, Kidneys not felt; no ascites; no enlargement of liver; edge of spleen palpable. Central nervous system: nothing abnormal. Fundus oculi: pale and granular. Discs not swollen but ill-defined (right more than left).

Blood.—R.B.C. 3,125,000 per c.mm., Hb. 36%, C.I. 0·6, W.B.C. 6,000 per c.mm. *Differential:* Polys. 33%, lymphos. 61%, monos. 3%, eosinos. 1%, basos. 1%, neutrophil myelos. 1%, nucleated red cells: 12 seen in counting 200 leucocytes. Polychromasia, poikilocytosis, anisocytosis.

Skiagrams.—Skull: general metastases with evidence of intracranial pressure as shown by widening of sutures. Long bones: metastases in femora, humeri, etc., and also in pelvis.

Section of Radiology.

President—Professor J. M. Woodburn Morison, M.D.

[*February* 19, 1932.]

The X-ray Treatment of Chronic Mastitis and Certain Leukæmias.

By Russell Reynolds, M.B.

I.—The X-ray Treatment of Chronic Mastitis.

I am using the word "mastitis" in the sense in which it is used by Mr. Sampson Handley for the condition so well described in his Bradshaw Lecture, 1931. Three or four distinct types of chronic mastitis present themselves for treatment:—

(1) The early chronic mastitis, in which there is increased cell-production and hypertrophy and increase in the number of the acini. The matrix around the acini shows an unusual number of hyaline connective tissue cells and enlarged ducts with hypertrophic epithelium forming irregular projections into the lumen.

(2) The more advanced stage of chronic mastitis, in which the elastic tissue of the smaller ducts disappears while the acini and epithelial ducts become surrounded with wavy fibrous tissue—in fact, new connective tissue. There is also fibrosis in the interlobular fat. Owing to the natural structure of the breast, these areas of chronic mastitis usually assume a wedge-shaped form, broadest at the base and coming to a point at the nipple. The part most frequently affected is the outer and upper quadrant of the breast. The condition may follow a preceding acute mastitis due to trauma or it may be due to local pressure of the clothes or some similar irritation. These cases appear to yield quite readily to small doses of X-rays at a low potential of about 80 kilovolts (0·155 Ang. units). In treating some 150 of these cases I have found that the most suitable dosage is a half erythema dose (or 3 H) of unfiltered rays to the surface. Three such doses are usually required, given at weekly intervals: occasionally two doses will suffice, but sometimes as many as six are required. These doses may seem very small and weak, but in my experience I find them sufficient.

The clinical picture is somewhat as follows: Patients come with one or both breasts slightly swollen and tender in certain areas. The condition is frequently bilateral and sometimes symmetrical. Usually these areas take the form of wedge-shaped sectors, one or more of the fifteen to twenty sectors into which the normal breast is divided; there is no retraction of the nipple. The patient may, or may not, complain of aching or shooting pains in the breast itself, which may pass up into the corresponding axilla, and the tenderness may vary from a mere suspicion of tenderness on deep pressure, to an acute tenderness felt at the slightest touch; often there is a palpable soft axillary gland. Usually, within seventy-two hours of the first treatment, the patient complains of some increased fullness in the breast with discomfort or increase in the tenderness. If the breast is examined at this time, it will be found to be slightly swollen. These signs disappear within the next forty-eight hours and about seven days after the treatment the mastitis has definitely diminished. The same cycle of events usually follows the second and third doses, only with decreasing intensity. Within a fortnight of the last dose the patient's condition is relieved. Individual cases vary considerably. It may happen that a week after the first dose the increased swelling and tenderness mentioned above have not completely abated; it is then better to delay the next treatment for a few days, making the interval either ten days or a fortnight. It is to be remarked that in such cases as the above the patients will nearly always have the same reaction period. That is to say, should they require treatment at any future time, the doses would have to be rather further apart than the usual week's interval. Some patients, on the other hand, never experience this increased swelling and tenderness; the mastitis diminishes progressively. It may be mentioned here

that when a menstrual period intervenes, the reactions mentioned above are generally intensified and lengthened.

(3) Then there is the type of chronic mastitis which occurs at the climacteric affecting both breasts simultaneously and usually uniformly. This type is as a rule less yielding to treatment. In such cases I usually begin by giving the dosage mentioned above, which may be quite successful but may have to be prolonged—that is to say, a greater number of doses must be given. Should this prove unsuccessful, shorter wave-length treatment must be given at a potential of about 135 kilovolts with a filtration of 2 mm. aluminium. Usually two or three half erythema doses at weekly intervals in these cases is sufficient to relieve the condition.

(4) Sometimes chronic mastitis presents cystic formations, the so-called "Schimmelbusch's disease." The cysts are formed by the dilatation of the ducts in the lobules of the breast tissue. Papillomata may or may not be present in the cysts. This form of chronic mastitis is nearly always accompanied by the milder form mentioned above which manifests itself as induration around the cystic areas. On treatment with doses at 80 kilovolts the indurated areas soon lessen and disappear but the cysts remain. When these cysts are simple in character they may also diminish in size if doses at 130-140 kilovolts are given, but when the cysts are almost solid with papillomatous growth they appear to be unaffected and to require deep X-ray exposures at something like 180 kilovolts, such as one would give in the treatment of a true carcinoma.

The success of the treatment in simple cases of chronic mastitis by small doses of long wave-length X-rays at 80 kilovolts may be accounted for in the following way:—

It is probable that a condition of mild hyperæmia is produced, with increased flow of lymph—that the small lymph vessels dilate, rendering the flow of lymph freer. This, of necessity, would relieve the lymph stasis which appears to be one of the chief factors in the causation of the proliferation of the epithelium lining the acini and ducts which is recognized as a precancerous state; so that this mild X-ray treatment may act as a prophylactic against the onset of carcinoma.

II.—The X-ray Treatment of Certain Leukæmias.

The X-ray treatment of certain forms of leukæmia was thoroughly dealt with at the annual congress of the British Institute of Radiology, held in December, 1931.

The one point on which all the speakers were in agreement was that the nature of leukæmia is not at all clear. Whether it be the lymphocytic or the myelocytic variety of the disease the pathology is still unknown. Is it neoplastic in origin or is it an infective process? One thing is certain, that irradiation by X-rays or radium has a profound effect, and may be regarded at present as our most important weapon. It also seems clear from one's own experience during the last eighteen years, and from the experience of others, that irradiation treatment is only palliative and not curative. In all the cases I have treated I have carefully watched the blood-count, and the wider one's experience, the more one is convinced of the necessity of keeping the red count and hæmoglobin up to the normal. The danger is that patients may drift into a condition of severe anæmia, with a low white count and diminution in the number of the red corpuscles. This seems to be the chief danger run in treating such cases with X-rays at a high potential. The chronic lymphocytic and the chronic myelocytic types of the disease certainly respond best to treatment.

In 1914, before the advent of high potential therapy, I treated cases of both these types of leukæmia with small doses of X-rays at low potential, with very satisfactory results, irradiating both the spleen and the ends of the long bones. Results were checked by the blood-counts and the clinical aspect of the patients. One case stands out prominently in my memory, in which the white cell-count was over

700,000. This patient had to be carried into my room on a stretcher. He had an enormous spleen and was very dyspnœic. After some weeks' treatment, the white cell-count dropped to 12,000 and he appeared in every way to be in good health, the spleen having returned almost to its normal size. These doses were of necessity very feeble ones, as the tubes were small gas-tubes and could carry little current. To-day I always begin treatment with small doses at about 80 kilovolts, usually 1 erythema dose (or 5 H) filtered with half mm. aluminium, and not until this irradiation has ceased to have any appreciable effect do I resort to higher potentials. As time goes on it is necessary to raise the potential progressively in order to get reaction. In severe cases where the spleen is greatly enlarged and the abdomen distended, and where there is a large white count, it may be necessary to begin with small doses of X-rays: often half an erythema dose is sufficient, otherwise one runs the risk of producing too severe a reaction with acute exacerbation of symptoms which may prove fatal.

It seems in these days that too much attention may be given to high voltage therapy in the treatment of such conditions as we are discussing. If one can obtain good results with the less penetrating type of X-rays which are apparently less harmful and destructive to the tissues, it seems to be the ideal to be aimed at; for is it not most necessary to keep the patient's general health up to as high a standard as possible and aid the body's natural power of resistance to the disease?

Another point to be observed is that, should a patient recover and not require treatment for some months, it is possible to commence again with low voltage therapy. In this way one can continue to treat patients intermittently for prolonged periods should they require it.

Discussion.—Dr. HERNAMAN-JOHNSON said that he was in complete agreement with the paper. He could not be accused of unduly favouring big doses of high voltage rays, but there were certain obstinate forms of chronic mastitis, with permanent enlargement of the breasts, which would yield only to a comparatively large dose of rays generated at a voltage of the order of 200 kilovolts. Such a dose caused a severe reaction, and it was as well to avoid the patient for the next month or so if possible, but after the disturbance settled down the result was usually good.

With regard to the treatment of leukæmia, he agreed that it was most important to maintain the red blood-count; to assist in this he was in the habit of alternating courses of ultra-violet light with X-rays.

Dr. GILBERT SCOTT said there were several important points that should be observed when treating leukæmia by X-rays. The dose should be kept down to a minimum and it should include a large field and the use of a medium wave-length. In addition, the leucocyte count should not be reduced to normal, a count in the neighbourhood of 10,000 being usually the level at which the patient felt his best, and this level should be maintained. Further, though the use of radium and short wave X-rays might give immediately satisfactory results, the patients soon lost their radio-sensitiveness and refused to respond to further radiation. This was a serious disadvantage. He had been able to keep several patients under control for many years by working on the minimum dosage method.

Dr. DOUGLAS WEBSTER said that with regard to the histopathology of mastitis, he had been unable to decide between the widely differing views of Mr. Sampson Handley and Sir Lenthal Cheatle. Clinically, one could differentiate a number of types, depending on the area affected, the size of the nodules or masses, their cystic change or not, and the size of the breast as a whole. For small breasts with pea-like nodules in one quadrant, he thought Dr. Russell Reynolds' method at 80 kilovolts unfiltered might suffice, but owing to the excessive value attributed by Dr. Moppett to 80 kilovolts radiation, he suggested that Dr. Reynolds should try say 60 or 100 kilovolts and see if he did not obtain equally good results as with 80. He (the speaker) usually cross-fired the breast at 120 kilovolts with 3 mm. Al filter; large breasts were treated at 180 kilovolts and 0·5 mm. copper or zinc filter. He had had about 100 mastitis cases, and a good result had been obtained in 87%; a few cases had been operated on for continued pain (? neuralgia), and one patient with a very large breast, who had been lost sight of for about a year after a course of medium-voltage

treatment, had reported with a fresh mass, which proved, on operation, to be malignant. Such a patient, if treated now, would have high-voltage treatment; and all such cases in which there was any suspicion of malignancy should be examined for some years at frequent intervals.

Dr. J. E. A. LYNHAM referred to interstitial mastitis accompanied by periodic pain of a neuralgic character. Though the swelling and infiltration disappeared the pain sometimes persisted and was not relieved by X-rays. He agreed with other speakers on the need for great care in the treatment of chronic diseases of the blood, which might be controlled for long periods by careful X-ray applications checked by repeated blood-counts, whereas over-dosage might do more harm than good.

Recent Advances in the X-ray Treatment of Asthma and Rheumatism.

By S. GILBERT SCOTT, M.R.C.S., L.R.C.P., D.M.R.E.

THE two conditions I have chosen, namely, asthma and rheumatism, may possibly be closely allied, for it is not unusual for a patient to state that the precursor of an attack of asthma is the swelling and painfulness of certain joints, usually of the hands.

ASTHMA.

In what year, or by whom, X-ray therapy was first used for the treatment of asthma, I am unable to determine. Much has been written on the subject: Gerber, among many other workers, concentrated on the treatment of the lungs; Pohlmann obtained good results by radiation of the spleen, as might be expected, since asthma is essentially of metabolic origin. My impression is that any good results that may have been obtained by radiation of the thorax can be explained by the accidental inclusion of the spleen in the radiation field. Another worker treated the pituitary gland. This might be called a despairing effort to obtain results.

The method which I advocate was first described in 1926 and is used with some modifications at the present day. Workers, both in this country and in America, have found it of great value, and I feel that it should be more widely utilized. The method attacks the problem of asthma from a new angle and it may interest some of you if I briefly describe it. Let me mention that the beneficial effects were brought to light by chance while I was, as a routine, at the London Hospital, irradiating the whole trunk to prevent and destroy metastases in malignant disease. I soon found that uncomplicated asthma was without doubt influenced. I have modified my method from time to time until now I find the best results are obtained, with the least disturbance to the patient, by excluding the thorax entirely from radiation. One large field is used for the abdomen and one for the back, lead rubber protecting the thorax and genitals. Working in the medium wave-length scale, the dose is so regulated that the patient's saturation or tolerance dose is fully maintained for the whole series.

Intensive, or so-called "deep" therapy, must on no account be used, if damage to the patient is to be avoided.

The remarkable increase in weight, general feeling of well-being, loss of nasal catarrh, and other phenomena which coincide with the disappearance of the asthma, support my theory that the beneficial effects of this method of radiation in asthma is attained through some metabolic channel, comparative to protein shock.

For those interested in the subject, a report, read at the Second International Radiological Congress, on the results of the treatment of 120 cases, will be found in the *British Medical Journal*, 1929 (i), 9.

RHEUMATISM.

I have been listening this afternoon to an interesting paper by Dr. T. G. Kahlmeter on the treatment of rheumatism. A large portion of this was devoted to results obtained from X-ray therapy at the Clinic in Stockholm. Dr. Kahlmeter states not only that it is essential for every clinic for the treatment of rheumatism to possess an efficient diagnostic and therapeutic X-ray department, but that he believes that X-ray therapy will eventually supplant many other forms of treatment.

My experience at the British Red Cross Clinic for Rheumatism bears out what he says, but I must add that until our knowledge as to dosage, that is, the best combination of wave-length and filter, etc., is more precise, we shall not make much progress.

He advocates small doses at frequent intervals, and though I am in agreement with this I consider that the type of ray used at the Stockholm Clinic is too penetrating. It is, after all, the soft tissues that are primarily at fault, not the bone. I have tried out various combinations and find that with the one exception of the hip-joint, which is the only deep-seated joint in the body, a quicker response is obtained with the use of X-rays of medium wave-length—110 kilovolts with aluminium filter.

The position of the joint when treated is also important.

In the osteo-arthritic and infective conditions I radiate individual joints. The rheumatoid arthritic group of case, however, does not respond to this method.

I am at present trying the effect of general radiation of the spine and abdomen, as I consider this arthritis to be of metabolic origin. The results so far, however, are not very encouraging.

The osteo-arthritic group, if not of too long standing, responds well, that is, in being rendered symptom-free. It is of interest to note that in two cases opaque bodies in the joint gradually disappear during the course of radiation. Osteo-arthritis of the hips varies considerably in response and appears dependent on the duration of symptoms.

Gout has not yet been treated, as I did not anticipate any response, except in the acute form, but Dr. Kahlmeter's results have stimulated me to include this type in future.

Spondylitis deformans in young patients—one of the most tragic conditions—responds in a remarkable manner if treated early enough, that is, within two years of onset.

Acute arthritis, such as gonorrhœal and active gout, respond rapidly.

I consider that X-ray therapy is not being utilized to its fullest extent and that its value in benign conditions should be more widely known.

While convinced that in years to come great strides will be made in the treatment of benign diseases by X-ray therapy, it appears to me that progress is being hampered, firstly, by the excessive amount of attention devoted to the treatment of cancer, and secondly, by the mistaken idea that maximum doses will produce the maximum benefit; this is no more true than in the use of drugs. So-called intensive or deep X-rays are being used indiscriminately.

Finally, let me repeat that until our knowledge of dosage is more precise, results are bound to be uncertain. Many practitioners will unfairly gauge the value of X-ray therapy from one single case. Eventually we may have the pharmacopœia giving the X-ray dosage for each disease. We should endeavour to obtain the maximum benefit with the minimum disturbance.

Discussion.—Dr. S. L. MUCKLOW said that after the publication of Dr. Gilbert Scott's article in the *British Medical Journal* in 1929 he (the speaker) had treated a number of cases following as closely as possible the technique described. The cases which he had treated might be divided into three groups, so far as their response to X-ray treatment was concerned. In the first group were those cases that had remained free from asthma from one to two years,

though further time must elapse before one could say that they were cured. In the second group were those cases in which the patient was free for a period of about nine months after treatment followed by a mild relapse which responded to further treatment. It was noticeable that in these cases subsequent attacks became progressively milder in type. Thirdly, there was a group of cases that remained free for about three months following the treatment and then relapsed. After further treatment they would again be free for another three months, but the attacks always recurred after a short interval.

He was interested to hear that Dr. Scott had now adopted the plan of covering the chest with lead rubber although he had previously recommended the irradiation of the complete trunk. He, Dr. Mucklow, had himself found that irradiation of the thorax was unnecessary and in the majority of cases the epigastrium alone had been treated, the thorax and pelvis being covered with lead rubber.

Dr. DOUGLAS WEBSTER said that the President had mentioned a case in which X-ray diagnosis of the chest had benefited a patient suffering from asthma. Similar results had been reported in other spasmodic conditions: for example, a case of congenital pylorospasm in which there had been a prolonged X-ray examination, and the spasmodic signs had disappeared suddenly fourteen days afterwards. In Vienna, pylorospasm, hyperacidity, and gastric ulcer had often been treated by X-rays: it had been noted by several observers that the spastic constipation from which such patients often suffered was also relieved; it was probably a vagotonic symptom. The treatment might be a "protein-shock" therapy, or not, but it often proved efficacious; it might well be tried when medical means had failed, before resorting to surgical intervention.

He had had a good many cases of arthritis, mostly in the knee, in some of which benefit had resulted. Striking results had been reported, as in the case of a medical man aged 45, who had thought of giving up his practice owing to pain in the feet and in one hip: he exhibited the triad of calcified arteries in the feet, calcaneal spurs, and arthritic signs in the talo-navicular and smaller joints. After a course of X-ray treatment he was completely relieved. Similar patients, almost crippled, had recovered and were able to go mountaineering. Some arthritic patients had been relieved by X-ray or radium treatment applied to the tonsils.

Dr. HERNAMAN-JOHNSON said that no case of osteo-arthritis in middle-aged or elderly people should be considered altogether beyond palliation. Even in the most chronic—and, as judged by radiographic evidence, the most severe—cases, some lessening of pain and increase of mobility could be obtained. This statement, unfortunately, did not apply to cases of "rheumatoid" type with polyarticular lesions.

He was going to take advantage of the permission given to deal with non-malignant conditions outside the scope of the paper by referring to exophthalmic goitre. He had recently attended a lecture on this subject by a distinguished surgeon who claimed 90% of cures by surgery but admitted 65% by X-rays and had also said that operation was not made more difficult by X-ray therapy; and agreed, in subsequent discussion, that this should form part of the medical treatment whenever practicable. Yet there were many radiologists of the younger school who had no particular belief in X-ray treatment for this disease. In his (the speaker's) opinion this attitude was due to the use of comparatively large doses at long intervals. Treatment should be not less than twice and preferably three times a week, employing medium rays with low filtration, the skin dose being 1H or less. By this method, improvement, both subjective and objective, would be manifest in about three or four weeks as a rule.

There could be no doubt that if a drug existed with the same therapeutic record as X-rays it would be used as a matter of course in all cases, and it was sad to think that in a disease the incidence of which had increased threefold during the past twenty years, the number of cases treated by radiation had actually diminished.

Section of Medicine.

President—Dr. H. Morley Fletcher.

[*February* 23, 1932.]

Naked-eye Diagnosis: The Method of Ectoscopy of Dr. Eduard Weisz.[1]

By Dr. L. Schmidt, Pistany.

The aim of ectoscopy is to show outlines of the internal organs in the thorax and abdomen as well as certain pathological changes, by means of a special technique, using only the naked eye and no instrumental aid.

Working for many years with Dr. Weisz, I have been able to observe the rise of ectoscopy and have had an opportunity of assisting at its development and watching its ultimate triumph. That this was so slow is due to the fact that in Pistany we

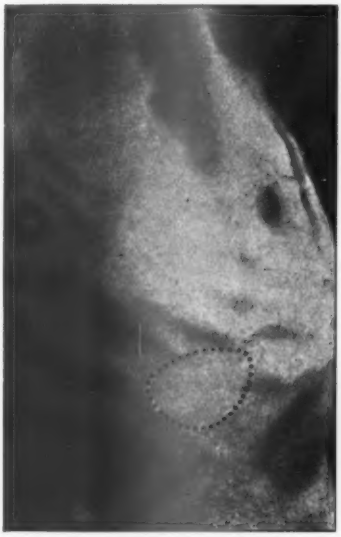


Fig. 1.

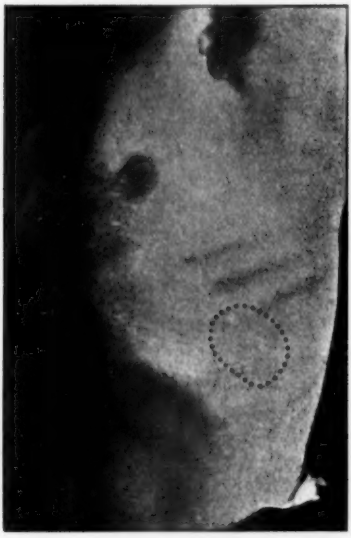


Fig. 2.

mainly treat patients for gout and rheumatism. In order to obtain suitable patients for ectoscopy we were obliged to visit foreign clinics for a number of years.

Now these obstacles have been surmounted and I am able to present you with the completed edifice of the new method.

First I would draw your attention to several points which are visible on simple inspection.

In the first two pictures (figs. 1 and 2) are two prominent circumscribed areas in the lower axillary region, showing no intercostal furrows such as are visible in the

[1] The paper was illustrated by cinematograph films.

surrounding area. These stand out like islands from the area of intercostal furrows and are therefore labelled the "spleen and liver islands." They correspond to the areas of the spleen and liver which are in apposition to the trunk wall and constitute the densest part of the corresponding regions of absolute dullness. It is not possible to go into further details here except to point out that the line joining their highest points indicates fairly well the level of the diaphragm anteriorly.

In the next picture (fig. 3), in the second and fourth subjects, the spleen islands are outlined. The anterior end of the lower curved line in each figure shows the lower margin of the costal cartilages and at its posterior end the lower border of the last rib. Considering now the upper curved line in the first figure, you will see a small darker portion corresponding to the anterior and posterior axillary line which has moved in the model with respiration; moving down with inspiration and up again with expiration. These alterations in position are described as the "respiration sign during quiet breathing" and indicate directly the lower limit of the lung or the

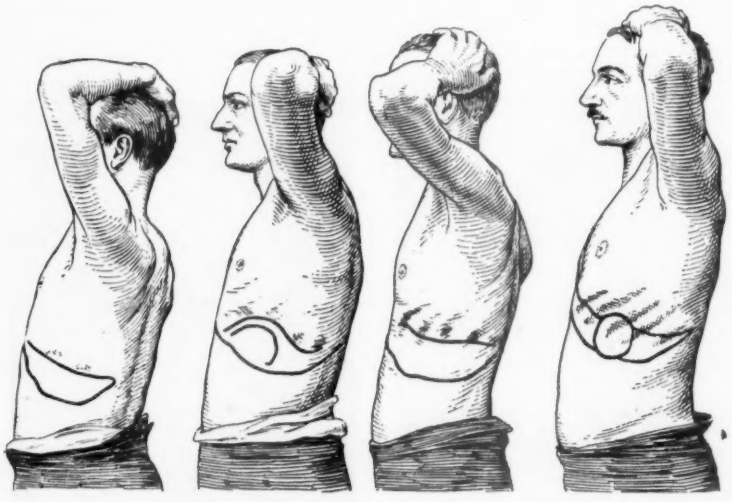


FIG. 3.

level of the diaphragm. In the second subject you see four such points of depression more clearly marked as is seen during the "snuff sign." For this the patient draws in his breath sharply through the nose with the lips shut as if taking snuff. Thus the level of the diaphragm all round the thorax is obtained. In the third and fourth subjects you see that prolonged furrow-like depressions appear if the "sniffing" is too vigorous and becomes instead a deep inspiration. As it is then not possible to determine accurately the line separating the spleen and the lung, i.e., the level of the diaphragm, it is technically important that the patient should not sniff too deeply.

The upper and lower curved line together give the "ectogram" of the diaphragm, in which the lower line indicates the lower limit of the thoracic cage while the upper corresponds to the level of the diaphragm.

In figs. 4, 5 and 6 you see the ectograms of the level of the diaphragm in four different people, taken from the anterior, and both lateral aspects. Without going into details these show how the diaphragmatic ectogram differs in each

FIG. 4.

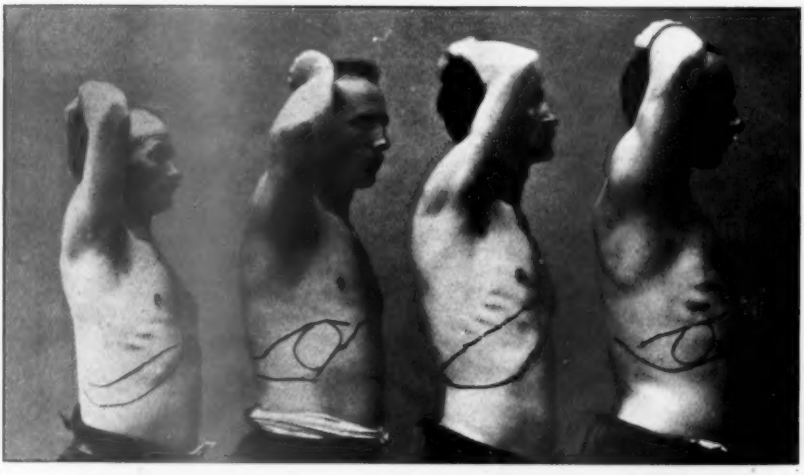


FIG. 5.

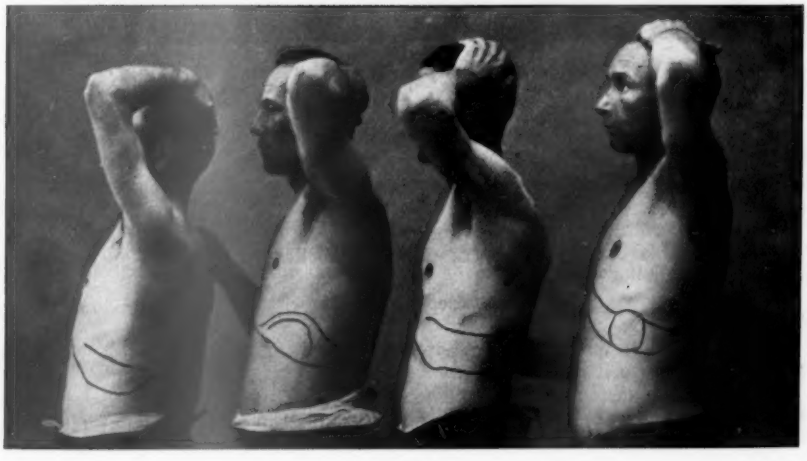


FIG. 6.

individual, a point of physiological and pathological interest. You will agree that it is very important that the two lines of the ectogram—the upper and lower curve—should be widely separated, showing that the pleurocostal sinus—the respiratory reserve space—is not used up and can act as a valuable reserve when an increased volume of air is required. On the other hand, if the two lines approximate, it indicates that the diaphragm is pathologically depressed as occurs in emphysema. Such people have no respiratory reserve and are more liable to break down with any exertion or illness. A perfect ectogram of the diaphragmatic level should be required in the routine examination of athletes and others who practise strenuous sports.

I will now pass on to another ectoscopic sign—"the intercostal speech sign." This, as opposed to the respiratory and snuff signs, shows not as a primary depression but as a primary elevation at one or more points in certain intercostal spaces. Here again some of the soft structures in any one intercostal space move more than others.

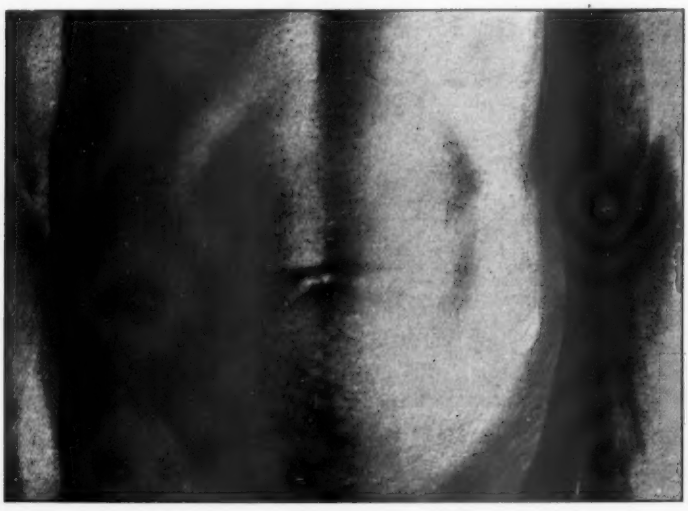


FIG. 7.

In the next picture (not reproduced) the whole of the right half of the thorax shows a phase of this intercostal protrusion, right down to the liver. These intercostal speech movements do not of course show equally well in all subjects.

Various "speech movements" can also be seen on the abdominal wall as well as in the soft structures of the thorax; they are labelled "abdominal speech signs" and are very valuable clinically.

I will next show you an instantaneous photograph (fig. 7) of the abdominal wall movements during speech.

Now let us consider the practical applications of these observations. What use is the "thoracic speech sign" clinically?

The clinical value depends on the following facts: (1) The intercostal speech movements cease at the borders of the lungs. Thus the lower borders of the lungs

are made visible to the naked eye. (2) Solid organs, such as liver and spleen, do not move but remain at rest during speech. They can thus be readily differentiated from aerated lung tissue. Thus the level of the diaphragm can be demonstrated. (3) Thickened pleura and tumours in contact with the thoracic wall do not move during speech and can thus be distinguished ectoscopically from surrounding aerated tissue. (4) The most important fact is that effusion moves during speech and can therefore be detected in the intercostal spaces. Thus the two following diagnostic difficulties have been solved: the lower limit of an effusion can be determined over the liver and spleen, and encapsuled effusions can be detected in the midst of thickened pleura, since the portion of an area of dullness corresponding to effusion or empyema vibrates during speech and thus becomes recognizable.

Before I illustrate the clinical value of the intercostal speech sign I should like to refer again to the ectograms of the level of the diaphragm. These were, as you

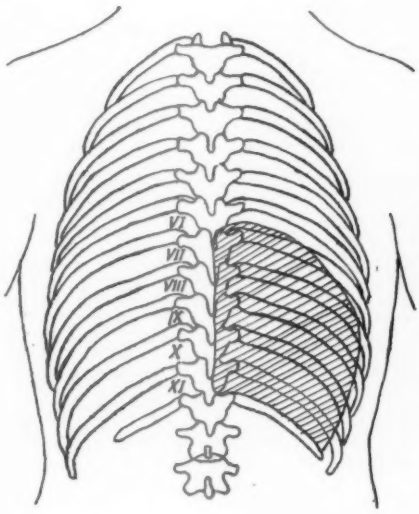


FIG. 8.

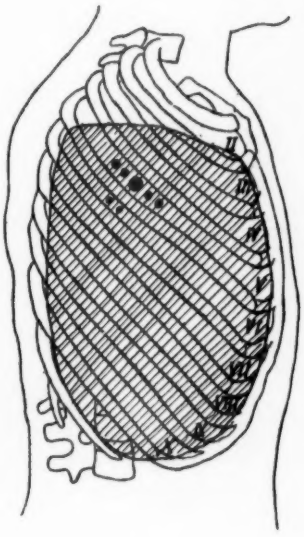


FIG. 9.

remember, produced with the aid of the snuffing device. The level of the diaphragm can of course be determined equally well by means of the intercostal speech sign, the two results generally corresponding exactly.

The main clinical use of the intercostal speech sign in pathological conditions of the thorax lies in differentiating fluid effusion, on the one hand, from liver and spleen, thickened pleura and tumours in contact with the chest wall, on the other.

The following pictures show this diagrammatically.

In fig. 8 you see on the right, below and posteriorly, a shaded area of dullness. This whole area remained immobile during speech. We could therefore assume that fluid effusion was absent; the dullness was due to solid tissue. Numerous attempts at tapping proved negative and post-mortem examination revealed a tumour.

The right side of the thorax in the next case (fig. 9) showed absolute dullness all over. The dull area did not move during speech, except for a small portion,

stippled in the picture, in the fifth and sixth intercostal space in the axilla. Here also the protrusion during speech was not typical, only some very fine—almost imperceptible—vibrations could be observed, which were more definite in the fifth than in the sixth intercostal space. A needle was therefore inserted in the fifth space (larger dark area) with the result that fluid was immediately reached. It should be noted that previous punctures at various points had all proved negative.

This example is of general importance in practice, i.e., if the active respiratory portion of a patient's lung is encroached on by, e.g., pneumonia or effusion, the progressive danger of the condition can be watched ectoscopically in the sound lobe by observing that the speech movements extend lower and lower.

I now show a picture of the same case in which, as a result of the speech sign, it was possible to withdraw fluid unusually low down. The percussion

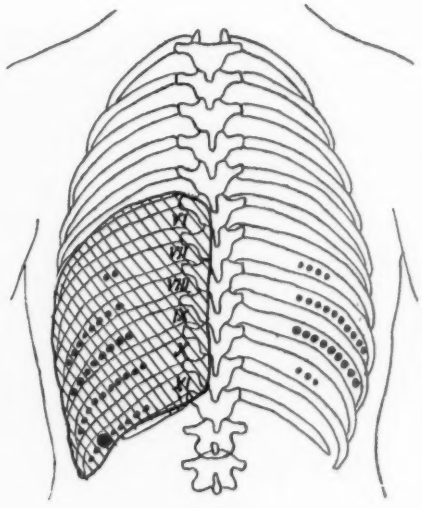


FIG. 10.

point is marked by a large disc between the posterior axillary line and the line of the scapula in the last intercostal space. The effusion had in this case undoubtedly become so extensive that the diaphragm was depressed; otherwise a puncture at this point could not possibly have withdrawn fluid (fig. 10).

The next two pictures (figs. 11 and 12) show a case of right-sided effusion, entirely covered anteriorly and laterally by thickened pleura. If you compare the two pictures you will immediately observe that the intercostal furrow seen on the sound left side is completely obliterated on the right side. While the left side showed all the ectoscopic signs very clearly, they are entirely absent from the corresponding areas in the front and at the side on the right side. The whole area was absolutely immobile ectoscopically. In the posterior part of the axilla, fairly high up about the level of the nipple, you will see a single small light area showing speech movements. It was at this point possible to withdraw fluid by puncture.

It was particularly interesting to notice in this patient how rigid the whole thorax was during ordinary respiration. Not a single rib moved even on the sound side. All the movement that could be seen during respiration on the sound side was in the intercostal soft tissues, and this was, of course, entirely absent on the diseased side with its thickened pleura. The patient was thus not using his ribs at all for breathing, but was breathing exclusively with the soft parts, the diaphragm. At the same time one could see on the sound side that the intercostal respiratory movements extended almost down to the costal margin. Simple inspection thus showed that on the sound side compensatory expansion of the lung had reached its

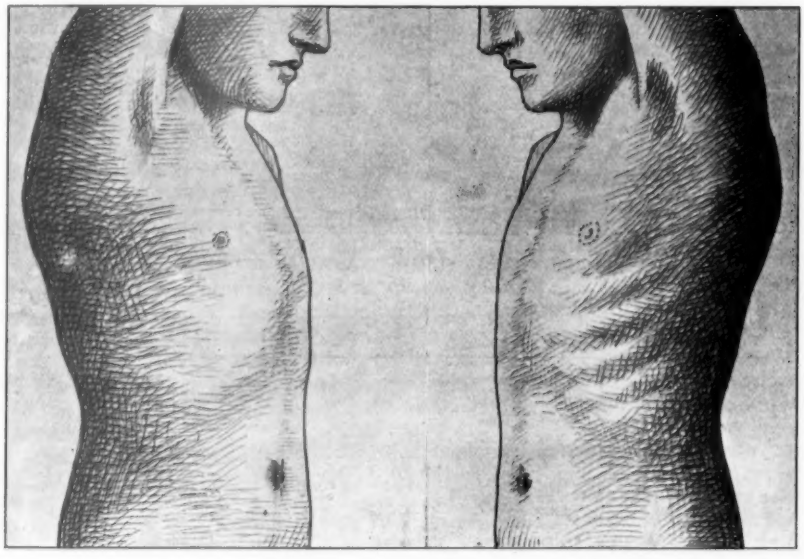


FIG. 11. FIG. 12.

maximum. From this one could immediately conclude that the lung tissue available for respiration on the diseased side was much diminished.

In the next picture (fig. 13) you see the diseased right side of the same patient taken from the side, so that the posterior part of the thoracic wall between the paravertebral and scapular lines is visible. Between the ribs you will see various light areas corresponding to the points at which the speech sign produces intercostal protrusion. It was therefore evident that thickened pleura was not present at these points as it was in the earlier picture and in the lateral and anterior parts of the thorax.

Whether, however, intercostal protrusions during speech are due to aerated lung tissue or to fluid effusion cannot be determined by ectoscopy alone, as they both move in the same way during speech. For this differentiation percussion is necessary. Only when intercostal speech movement and absolute dullness coincide can one be certain that fluid is present. Percussion in this case revealed dullness only in the lower two speech-sign-positive intercostal spaces and here on puncture fluid was found.

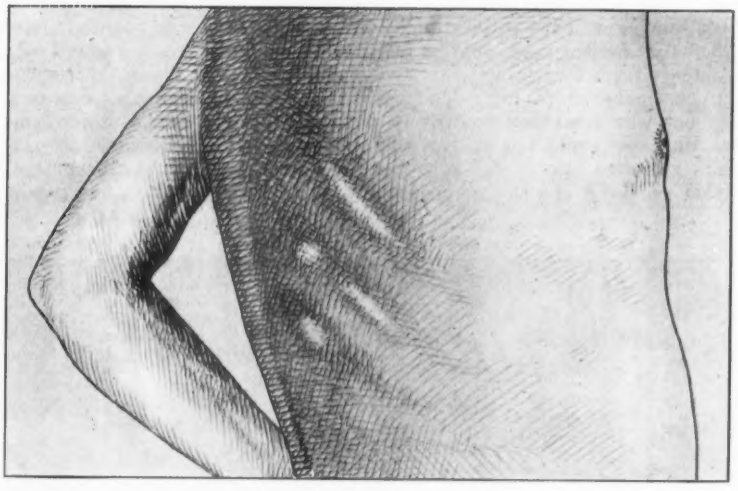


FIG. 13.

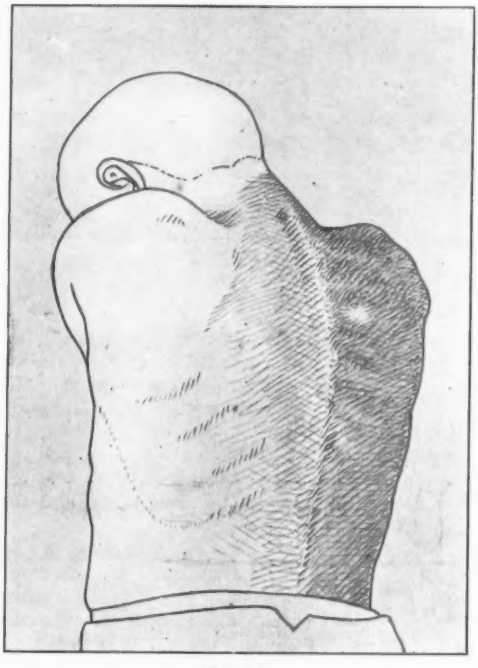


FIG. 14.

Summing up the whole case, ectoscopy showed that the right anterior and lateral part of the dull area was not due to fluid, while in the posterior axillary line at the level of the nipple a localized area was found. It was further evident that the posterior part of the thorax was free from thickened pleura.

It is thus evident that ectoscopy can demonstrate pleural effusion in complicated cases which even X-rays fail to elucidate.

In the patient shown in the picture opposite (fig. 14) there was interscapular dullness on the right side and there was some doubt as to whether this was due to localized effusion, empyema, or a tumour, as the patient was sub-febrile. Ectoscopy revealed in the middle of the rigid dull area a patch which vibrated slightly during speech. (The light area in the picture.) A puncture was therefore made at this point and this did in fact yield pus.

In a case of mediastinal tumour there was, on the right side, a limited area in which the intercostal spaces did not move during speech—in contrast to the rest of the intercostal spaces. The presence of a tumour in contact with the thoracic wall could therefore be diagnosed as there was no evidence, either in the history or clinically, pointing to thickened pleura.

It is important to remember that ectoscopy will give no evidence of a tumour deep in the thorax well covered with lung tissue. Only a tumour in contact with the thoracic wall interferes with the ectoscopic speech sign. The same applies when estimating the size of the heart; only the part in contact with the chest wall is revealed by ectoscopy.

Now we pass on to the value of ectoscopy in abdominal pathology.

The following principle applies to the internal pathology of the abdomen. Wherever there is peritoneal irritation, reflex muscular rigidity (défense) results, and speech movements are inhibited. An area in which speech movements are diminished as compared with its surroundings, or the corresponding point on the opposite side of the mid-line, therefore indicates the site of disease and in many cases even its nature. Thus the intra-abdominal condition is projected on to the surface of the abdomen.

You will see, e.g., in the film a case of duodenal ulcer in which the speech movements on the right side are to a large extent inhibited, also a case of perforated gastric carcinoma in which the speech movements in the left upper quadrant of the abdomen have entirely ceased. Then you see a woman in whom an ascending gonorrhœa has led to diffuse peritonitis; the abdominal wall hardly moves at all except for a small area round the umbilicus. In a case of tuberculous intestinal fistula in the region of the appendix it is somewhat surprising to find active speech movements, showing that the remaining three-quarters of the abdomen have remained healthy. Painful affections of the abdominal wall itself can of course also cause reflex inhibition. You will, e.g., come across patients who have been twice operated on for gastric ulcer in whom the lower abdomen operated on some time ago moves actively, while the upper abdomen recently opened does not move during speech, because the scar is still sensitive.

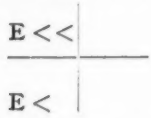
Finally, I show on the screen a diagrammatic sketch of a case of liver abscess. Clinically, a subphrenic abscess was suspected. Now we know that no part of the liver takes part in intercostal speech movements. In this case also the liver remained entirely immobile during speech, except for a small area which protruded and moved. At this point fluid must therefore be present. An exploratory needle was inserted and pus withdrawn and subsequent laparotomy discovered in fact a liver abscess.

As, however, taking cinematograph films is cumbersome and expensive we had to devise a method called "ectography" by which the transient impressions of the speech movements might be immediately recorded before they had faded.

A cross represents the four quadrants of the abdomen with the umbilicus at the centre. Ectoscopic movements are denoted by a capital E, their diminution by the

mathematical sign < (smaller). Increased inhibition is marked by E < < and complete immobility by E < < <.

The ectogram of the case of duodenal ulcer described above with right-sided inhibition of speech movements would be recorded thus :—



We see that the speech movements are diminished on the whole of the right side, more above than below.

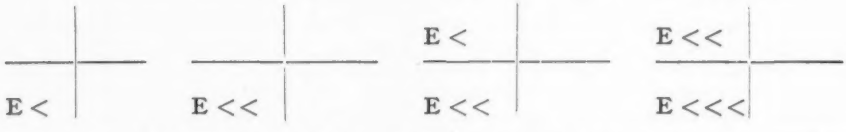
The next ectogram is that of the perforated gastric carcinoma :—

indicating complete speech immobility in the upper left quadrant, with normal movement over the rest of the abdominal wall.

The next ectogram shows a case of tuberculous fistula in the appendix region, with good speech movements elsewhere :—

A complete diagnosis can, of course, never be based on ectoscopy alone. This method only deals with one set of observations which can only be interpreted in conjunction with the history and other findings. Ectoscopic examination will show in which quadrant of the abdomen the affected organ lies but it will never demonstrate the affected organ directly. Further, speech inhibition occurs not only in a true peritonitis but also in peritoneal irritation and in various other conditions of irritation, e.g., impacted gall-stones and renal calculi, and probably in other colics. We see therefore that the ectoscopic findings should be applied with care.

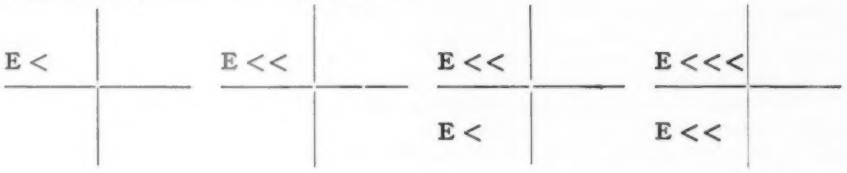
The next ectogram is a diagrammatic representation of a case of appendicitis :—



You see how the speech inhibition starts in the lower right quadrant and increasing in intensity and extent affects the whole of the right half of the abdominal wall.

Muscular rigidity due to appendicitis may extend right up into the upper part of the abdomen and be palpated there just as in pneumonia or pleurisy, as you are aware the appendix region often becomes rigid. As a result, as you are also no doubt aware, right-sided pneumonia and pleurisy occasionally reach the operating theatre with a diagnosis of appendicitis.

The next ectogram gives a diagrammatic representation of the course of a case of right-sided pneumonia and pleurisy :—



Here the ectoscopic signs are reversed, starting on the right and gradually extending downwards.

It has also been found useful in practice to incorporate in the ectogram of the abdomen the results of palpation. Increased rigidity—so-called "défense"—on palpation is marked by D > D >> D >>>

The ectogram cannot be regarded as complete until it includes the results of palpation.

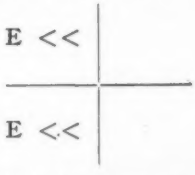
The next two ectograms are those of appendicitis and right-sided pneumonia or pleurisy respectively :—

In the former, increased rigidity is found below ; in the latter, above.

Thus ectoscopy and ectography will help particularly in children in differentiating the two conditions.

Applying ectoscopy now to neurology : in cases of paralysis the muscles do not move. As is seen in the film, in a case of hemiplegia one side remains immobile ; it is thus sometimes possible to demonstrate paralysis of these muscles before it appears elsewhere. Thus it may happen that the absence of speech movements, demonstrated by ectoscopy, may in many purely motor cases, or even in mixed cases, be the only early symptom for some considerable time, or in cases which have apparently recovered it may be the last remaining sign. Thus, in neurology also, ectoscopy fills a gap.

The following is an ectographic representation of a right-sided paralysis :—



From an ectogram such as this it is, of course, impossible to state whether the diminution in speech movements is due to a paralysis or a reflex inhibition from unilateral irritation. Palpation of the abdominal wall is therefore always necessary. If the condition is due to irritation there is always some muscular rigidity, and this is, of course, absent in flaccid paralysis. In spastic paralysis, however, some increased muscular resistance would be palpable.

I must mention that in a complete unilateral paralysis only the active movements on the affected side are absent, while, paradoxically, passive movements often appear to be increased on the paralysed side. For this reason it is often important to estimate the abdominal speech movements qualitatively as well as quantitatively; this is not very troublesome. Every flattening or depression of the abdominal region is a result of muscular contraction and must therefore be regarded as active, while local increased protrusion of the abdomen must be described as passive.

With regard to the speech technique required for the production of ectoscopic signs I should like to draw your attention to the following points: It is advisable not to let the patient speak continuously, as the trunk then becomes rigid and the signs cease. It is better to instruct the patient to repeat some suitable word, such as "Kitt," at intervals of two seconds. Also in comparing two points, it is important to see that the same amount of force is being used and that the position of the patient is symmetrical. As regards illumination, when one has had some practice this makes little difference, even a pocket torch being sufficient; the beginner is, however, advised to use light falling from one side at an angle.

Section of Ophthalmology.

President—Mr. ELMORE BREWERTON, F.R.C.S.

[*February* 12, 1932.]

Pulsating Exophthalmos.—EUGENE WOLFF, F.R.C.S.

Patient, a woman, aged 40, noticed that for the past seven months her right eye had been growing more prominent. There was also gradual diminution of vision with pain over the second division of the fifth nerve. Eighteen months previously she had accidentally knocked her head on the mantel-shelf.

The proptosis of the right eye is directly forwards: definite pulsation synchronous with radial pulse. No bruit in temporal fossa. Vision in right eye, with present glasses, which are D.−2, = $\frac{6}{24}$. With a retinoscopy, however, the refraction shows a myopia of only 1D. That, I think, is due to the eye being pressed on from the back, causing it to become flatter and thus relatively more hypermetropic. Right iris lighter in colour than left, right pupil smaller; reacts more sluggishly. Right fundus shows some dilatation of retinal veins, and some haziness at upper margin of disc, but no definite swelling. There are also some fine vitreous opacities. Mr. A. M. Zamora finds no evidence of disease in the nasal sinuses and Dr. C. C Beatty excludes Graves's disease as a cause of the proptosis. Wassermann reaction negative. Nothing abnormal in the renal fossæ. Skiagrams of orbit, nasal sinuses and pituitary fossa: nothing abnormal.

With regard to diagnosis: In view of the history of head injury, an arterio-venous aneurysm of the internal carotid artery and cavernous sinus is possible, but I believe the condition is more likely to be a vascular growth inside the periosteal cone. There is no difference on compression of the carotid artery.

Discussion.—Mr. RANSOM PICKARD said that the thrill elicited seemed to be of that fine vibratory kind which was present when there was a communication between two vessels, particularly between an artery and a vein. This fact would weigh much with him.

Mr. J. FOSTER suggested another source of tumour, namely, thyroid. A review had been made three years ago of all published cases of growth of the thyroid—960 in number—of which 20% first showed themselves by secondary, rather than by primary growths. Nothing was found in the thyroid gland itself until post-mortem examination. A considerable number of the 20 per cent. were pulsating tumours, and appeared chiefly in flat bones.

? Cerebral Tumour.—A. F. MACCALLAN, C.B.E., F.R.C.S.

Miss V. D. came to the Royal Eye Hospital December 10, 1931. She stated that in 1925 she had had a fall on the back of the head followed by ecchymosis about the right orbit.

On examination.—White visual acuity with correction was: right eye $\frac{6}{18}$, and left eye $\frac{6}{9}$, peripheral visual fields were contracted within 40-degree circle of perimeter, and blind spots greatly enlarged. Fields were charted weekly on six occasions and remained contracted to about same extent; the blind spots however increased in size.

The point of interest in the case was to account for the anomalies of the fields of vision, since there were no pathological changes in the fundi. Physiological pits were well marked. The tension was normal to the fingers, and with McLean's tonometer registered: right eye 30, left eye 35.

Wassermann reaction negative. Radiological examination: sella turcica normal. Nose, throat and ears normal. Radiological examination of the mouth showed an apical abscess in one tooth, and also a buried fragment of a tooth. Biochemical examination: normal sugar metabolism.

Résumé of a neurological consultation with Dr. James Collier:—

"The concentric contraction of the visual fields with increased blind spots is strongly suggestive of involvement of the optic chiasma, most probably by tumour in the pituitary region. The normal sella turcica, however, would suggest that the pathological condition is high up, that is, in the infundibulum.

The case presents several features consistent with Fröhlich's syndrome. There is an excessive deposition of fat throughout the body, especially over the sexual organs, which are more than normally tender. The axillary and suprapubic hair is sparse. Menstruation was late in starting—at fifteen years—and has been somewhat scanty since. The linea nigra is well marked, while there are pigmented spots all over the body (ink spots). Lacunæ are absent in some of the finger-nails, although present in others. There has been an increase in weight of one stone and a quarter in nineteen days. The patient shows some lack of emotional control.

These signs all point to endocrine dystrophy and to a pathological condition of the pituitary gland in particular. The normal sugar tolerance is not inconsistent with this.

It was noticed that the patient flicked her nose once or twice during the examination; while too much importance should not be attached to this, it may be noted that this action is said to be an early sign of cerebral irritation."

Comment.—It is believed that the signs point to some form of tumour causing pressure on the optic chiasma. However, the indications for operation are at the present time too scanty. The patient will be kept under observation and a further report will be made.

Further report (May, 1932).—Acting on the assumption that the condition was due to a tumour in the pituitary region, a three weeks' course of deep X-ray therapy was applied at Westminster Hospital under the care of Dr. Allchin. At the end of this period it was noted that while the visual fields, when delineated with the perimeter, remained contracted to the same extent as before, when estimated by means of the movement of objects at a distance of several metres, they appeared to be full. It appears that there is a large functional element in the case, and that perhaps there is no pathological condition present since the perimetric fields are not consonant with the fields estimated by movements of the hand or similar-sized objects at a distance.

Congenital Nuclear Hypoplasia of the Facial and Oculomotor Nuclei, with other Congenital Abnormalities.—O. GAYER MORGAN, F.R.C.S.

A boy, aged 11, has had bilateral facial paralysis and inability to move his eyes laterally since birth. The lesion is associated with other congenital malformations, in his case webbing of fingers and talipes equino-varus. After birth there was considerable difficulty in his sucking action, and he was more successful at the breast than with the bottle. There has been difficulty with salivation and epiphora from the start.

On examination.—The boy is intelligent and his vision good, but the upward movements of his eyes are limited; downwards the movements are good, with very slight convergence when a great effort is made. There is no lateral movement of either eye separately, or of the two eyes together. Dr. H. Cameron tells me that he

has seen a similar case, in which, however, there was absence of nipple on one side and some fusion of ribs and malformation of the fingers. Apparently all these cases, though somewhat similar from the ocular point of view, differ in respect of their congenital malformations. The interesting point about this patient is that there is no convergent squint of the eyes, although the third nerve is apparently intact.

I take this to be an illustration of the truth of the view that the innervation of the internal recti comes from the sixth nerve nucleus.

Mr. A. E. ILES said that he had seen a similar case. The patient was a mental defective with bilateral facial palsy. When the attempt was made to get him to move his eyes to the right or the left he had a marked convergent squint in both eyes, and in this case when one covered up one eye there was a weak lateral movement, although when the patient looked straight ahead there was no apparent squint.

? Cyst. ? Tumour on the Iris.—ROSA FORD, M.B.

This patient, a girl, aged 14, has a swelling on the upper part of the right iris, of a yellowish colour, and having a nodular surface, on which are vessels; on the lateral surfaces there is some pigment. The swelling slightly overlaps the pupil but does not extend to the angle of the anterior chamber. It can be seen also to bulge a little backwards.

There are no signs of inflammation and the pupil dilates evenly. There is no history of injury.

When first seen a year ago, the swelling had the appearance of a flaccid cyst, but now it looks like a solid tumour. It has definitely increased in size in the interval. The mother states that a brown speck was noticed when the patient was a year old, but that it only began to grow two years ago.

I should be glad to have opinions as to its nature and the best method of treatment. Removal by a large iridectomy seems to me the best course.

Discussion.—Mr. T. HARRISON BUTLER said that he had now under his care a case practically identical with this, except that in his case the growth was at the bottom. The patient was a woman aged 40, and had noticed the growth for two years. He had been watching her for a year, and there had been no alteration in size or consistence of the growth in that time. The growth had since been treated with radium at the Radium Institute, and was now beginning to look anæmic and flatter, and of less sharply defined outline. Both the speaker and the staff at the Radium Institute thought that it was becoming smaller. He had shown the case at a meeting of the Midland Ophthalmological Society. He thought that the growth was an endothelioma. He felt disinclined to do anything unless he saw signs of increase in size. Recently the patient had said that she had a feeling as of a marble in her throat, probably some dysphagia, and, fearing there might be secondary growth, he had arranged to have the œsophagus examined. In Miss Ford's case he thought that radium should be given a good trial.

Mr. M. S. MAYOU said that in the *British Journal of Ophthalmology*, 1930, xiv, 152-157, he had published some cases of pigmented tumours of the iris, amongst which was a case somewhat similar to this. The patient was seen fifteen years before the eye was removed and a drawing was made of it. Just before the operation the tension had begun to increase and the patient complained of a little mistiness of vision. On pathological examination the tumour was found to have become definitely malignant and to be spreading back into the ciliary body. Increase of tension was an important factor in showing whether a simple tumour was becoming malignant.

Increased tension was also shown to take place in some of the other cases in the paper quoted, being due to the cells of the tumour spreading round the angle of the anterior chamber and blocking it.

Shrunken Lens for two years in the Anterior Chamber.—ROSA FORD, M.B.

This patient, a woman aged 77, had had for many years a cataract in her right eye, which I did not remove because projection was very uncertain at the time when I first saw her, ten years ago. After an attack of iritis, two years ago, the contents of the lens were seen to be fluid and partial absorption took place, so that the patient could see large objects.

The iritis tended to recur and the eye became increasingly painful until, two years after the lens became fluid, and two years ago, the shrunken lens suddenly slipped into the anterior chamber and has remained there ever since.

It rests on the lower angle of the chamber but is freely movable. No further absorption has taken place. Immediately after the dislocation, the eye became much less painful and during the last year has given very little trouble. At present it is quite free from pain. I do not propose operation while it remains comfortable.

Two cases of ? Doyne's Familial Choroiditis.—J. FOSTER, F.R.C.S.

These patients are two brothers, Hebrews, aged 23 and 30. Both are shop assistants. Three other brothers in this family and one sister are normal, and another sister has not been examined. The son of the elder brother shown is normal.

(I) M. K., aged 30. Tonsillectomy at age of 11. No other illness. His sight began to fail two years ago and he could not see a tennis ball in play. One year ago his sight was much worse and now he cannot read except in a good light.

Vision: (24.2.31)—R. $\frac{6}{24}$, L. $\frac{6}{18}$. 2.6.31—R. $\frac{6}{36}$, L. $\frac{6}{24}$.

Medical, dental, nose-and-throat, and urine examination: Nothing abnormal.

The blood picture shows slight polymorphonuclear leucocytosis—76%. Total 13,100.

Ophthalmoscopic examination.—Around each disc for a distance of about 3 disc diameters is a roughly circular area of rather vague yellowish spots, rounded in contour, and variable in shape and size from about one-eighth to half the area of the disc. They are behind, and rather more dense near the retinal vessels, and in parts follow a roughly honeycomb pattern. There is a little pigment round their edges. The spots encroach on the macular area, which seems slightly darker than usual and shows one or two small bright spots in addition. The rest of the fundus and media normal. Fields are full and there is no scotoma.

(II) H. K., aged 23. Past history of psoriasis at from 8 to 13 years.

His sight has been failing for a year; he first noticed difficulty in a cinema. Reading is becoming more difficult and letters tumble into one another. All general investigations negative as in the case of his brother.

Vision: R. $\frac{6}{24}$, L. $\frac{6}{12}$. Not improved, 15.12.21.

The fundus condition is somewhat similar to the brother's, but it extends rather more peripherally, and there is more pigment round the edges of the spots. He has, in addition, bilateral anterior, axial embryonic cataract, and polychromatic lustre on the posterior surface of both lenses. The media are otherwise clear.

These two brothers are shown by permission of Mr. W. H. McMullen, whose clinic they attended. The appearance, the age of onset, the negative investigations in other directions and the family relationship, suggest that they are of the same nature as the familial choroiditis described by Doyne in 1896. No pictures of this disease are available in the literature and Doyne's original picture appears to be lost. Any suggestion as to treatment would be welcomed, as the younger is reduced to

spiritualist treatment (namely, application of cold water to the back of the neck and drinking grape-juice), which he is using without much faith.

Discussion.—Mr. AFFLECK GREEVES said it was a pity that the term choroiditis was applied to these cases. Choroiditis implied an inflammation, yet no one would suggest that these cases were inflammatory in origin. The most likely histological condition was a colloid body formation on Bruch's membrane. Colloid body formation might be a congenital manifestation, and in many cases it had little or no significance, but it might also be associated with a degenerative process.

Mr. HUMPHREY NEAME said that these cases might possibly be allied to the groups of cerebro-macular disease, of which some cases had been reported, with a fine peppering of the fovea, sometimes with a familial history, with cerebral degeneration developing later. Mr. Leslie Paton might remember a case in which there had been a fairly marked foveal change, with $\frac{6}{9}$ vision. The patient had a central scotoma, and when the fundus drawing was made a few years ago no colloid bodies were present. When he, the speaker, saw him there were colloid bodies, as in the present case. These cases were similar, and might deteriorate further, and show marked foveal changes.

Mr. E. TREACHER COLLINS said that the late Mr. Doyne had given to him, the speaker, the backs of the eyes from one of his cases to examine pathologically, and he had found hyaline degeneration of the retinal pigment epithelium on the inner surface of Bruch's membrane; there were considerable conglomerate concretions of hyaline tissue, much larger than in "Tay's choroiditis." He still had the back of one eye mounted as a macroscopical specimen and microscopical specimens of the other, of which a drawing was published in *The Ophthalmoscope* (vol. xi, 1913, 537). A number of drawings showing the ophthalmoscopic appearances, from cases in several members of the same family, were framed and hanging in the Oxford Eye Hospital.

Secondary Carcinoma of the Orbit.—PHILIPPA MARTIN, F.R.C.S.

Patient, a woman aged 66. Left breast removed for carcinoma September, 1929. Up till four and a half months ago, remained free from recurrence. Then she returned to University College Hospital with misty vision of left eye. Mr. Humphrey Neame found early cupping in both eyes; increase of tension in left eye and left pupil larger than right. Loss of whole nasal field.

Five weeks afterwards left eye was trephined (Mr. Neame). Two days after operation patient was unable to look downwards; three days later, almost complete ophthalmoplegia with ptosis and slight proptosis. Proptosis increased steadily and almost total anæsthesia developed over area supplied by ophthalmic division of fifth nerve. Lower half of field was lost in first few days; upper half lost during second week; at end of three weeks there was optic atrophy and perception of light was lost.

Shortly before this a hard lump was found at upper and inner angle of orbit. Skiagram showed globe obscured by irregular opacity. Diagnosis: orbital neoplasm.

From a consideration of the clinical evidence it would appear that the growth began on the outer side of the optic foramen and, at an early stage of its development, infiltrated the optic nerve. From this point it spread in two directions, outwards into the sphenoidal fissure and forwards along the inner wall and roof of the orbit.

Deep X-ray therapy was commenced eight weeks after the first symptoms and the patient had had eleven exposures without appreciable retardation of the forward spread of growth towards the orbital margin. Recently, infraorbital œdema has developed. This is comparable with the œdema of the arm which so commonly follows destruction of the axillary lymphatics in cases of carcinoma of the breast.

The patient is presented as a case of secondary carcinoma in view of the known primary focus in the breast. I propose to treat her with radium and hope to show her again at a later date.

I am indebted to Mr. Humphrey Neame for permission to show this case.

Hæmangioma of Retina.—W. E. HEATH, M.B.

L. C., a girl aged 23, attended hospital August 30, 1931. She had noticed for the past eight months that she was not able to see immediately in front of her with the left eye.

On examination.—Right eye normal. Right vision $\frac{6}{6}$. Left eye appeared to be normal, but pupil reaction to light was more sluggish than that of right eye. No central vision; patient able to appreciate hand-movements only in inferior nasal quadrant. Tension was normal; media clear. On examination with the ophthalmoscope the most striking thing was the enormously dilated and tortuous superior nasal vein. By its side was the superior nasal artery, also dilated but not to the same extent. Temporal side of disc sharply defined, but nasal half obscured, and exact place of entry of dilated vein could not be seen. In upper part of retina was a clear detachment, along which convolutions of vein could be traced, and into which it seemed to dip. At extreme upper periphery was a globular cystic mass, probably a final convolution of the vein. In lower half of eye was a further detachment, but vessels on this were not abnormally dilated; at apex of this detachment could be seen a white spot looking like a hole.

Patient was examined by Dr. W. J. Adie, who could find nothing abnormal, and nothing to suggest an intracranial angioma. Nothing of interest in family history. Wassermann reaction negative.

Since the drawing was made in September, 1931, the detachment above has increased considerably.

Bedell has recently published three similar cases, and in an exhaustive search of the literature has found records of less than 100 cases. The first case was described by Fuchs in 1881.

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Mr. E. TREACHER COLLINS said that the condition was often found in several members of the same family. Some members, as Rochat[1] had shown, might have cerebellar disease, and others affection of the eye. Sometimes cerebellar disease did not manifest itself until a long time after the eye disease. All these cases ended ultimately in blindness of the affected eye, and naturally the question arose as to whether anything could be done to check the progress of the disease. Radium had been tried, and he had suggested that in an early case, where there was a circular mass in which an artery and a vein seemed to terminate, it might be possible to do some good by electrolysis, passing a needle into the mass with the other pole outside.

Exfoliation of the Iris Stroma, with Aplasia of the Anterior Mesodermal Layer.—FRANK JULER, F.R.C.S.

Patient, A. W., female, aged 62.

History.—Senile cataract, both eyes, condition of right iris noted at time of admission to hospital for extraction of left cataract in July, 1931. Healing of left eye was uneventful; $\frac{6}{6}$ vision after needling.

On examination.—Right iris: grey stroma in upper half; deep crypts in lower temporal quadrant; torn fibrils in lower nasal quadrant; exposed sphincter muscle; intact pigment layers.

[1] *Klin.-Monatsbl. f. Augenheilk.*, 1927, lxxviii, 601.

The sphincter muscle can be seen standing out naked as a lighter brown structure on the dark brown area. Short tags of torn fibrils are attached to the pupillary margin, and longer tags are hanging on to the periphery.

The question as to ætiology is interesting. There is no history of trauma in the case. The iris in the other eye from which a cataract was removed eight months ago shows nothing similar. Whether this can be altogether a congenital anomaly is doubtful; it is probably an atrophy superimposed on a congenital condition. The embryonic atrophy of the mesoderm of the iris may be continued and affect the deeper layers, so that later in life this rupture of the iris fibrils may come about.

Differential Diagnosis of certain White Deposits seen in the Fundus.

By MALCOLM L. HEPBURN, M.D., F.R.C.S.

I HAVE recently noticed a tendency at clinical meetings to describe those cases in which white or yellowish-white deposits are present in the fundus, either as "exudative retinitis" or "Coats' disease," though they have but little claim to be so regarded.

As any adequate discussion of the subject requires far more time than it is desirable to devote to one individual case, I thought it might be well to submit a short paper as a basis for discussion, so that, if possible, we might arrive at a more or less agreed opinion, because I feel that we should be careful not to hand down in ophthalmic literature a description of cases under a definite name, the correctness of which is assumed when no comment is made on the diagnosis.

The title of my paper has been expressly chosen with a view to the exclusion of white patches and deposits about which there is obviously no difference of opinion or difficulty in diagnosis.

Such cases are: (*a*) Metastatic inflammatory deposits. (*b*) Fibrous tissue development either at the macula or on the retina.

The term "exudative retinitis" implies an inflammation of the retina, accompanied by exudation of albuminous or hæmorrhagic fluid into its layers and this condition is strictly exemplified only in cases of retinitis due to renal disease, diabetes and diseases of the retinal vessels.

Such cases also never give rise to any serious difference of opinion, unless the exudates become excessive in amount or tend to encircle the macula, when I notice that writers on the subject begin to talk about "massive exudate" or "retinitis circinata," and sometimes draw comparisons between this and Coats' disease.

It is not surprising that the exudates in retinitis show a tendency to encircle the macula. Since their origin is from the retinal vessels, they tend to accumulate in the neighbourhood of the larger vessels which surround the macula.

It may be well now to remind ourselves of the points brought out by Coats in the original paper described by him as "Disease of the retina with massive exudate" in 1908.

These points are: *Clinical*—(1) The cases are rare, and found in young people. (2) The presence of extensive and widespread white areas, either one large one or several similar smaller ones in various parts of the fundus, with a tendency to leave out the macula. (3) The white areas are generally slightly raised and ill-defined, e.g. fan-shaped. (4) The disc is generally normal and has well-defined edges. (5) The vessels, if enlarged anywhere, show changes away from the disc, not on it. (6) When the vessels are altered, as is frequently the case, they show general enlargement, fusiform dilatation, and aneurysmal

enlargement. (7) Hæmorrhages are seen in many places. (8) The choroid is always unaffected.

Pathological and histological—(1) A cavity or cavities filled with debris, and bounded by altered retina and new-formed fibrous tissue, of which latter there is an excessive amount. These cavities are filled with disorganized red corpuscles and ghost cells (i.e. leucocytes filled with fluid), also cholesterin and coagulum. (2) Proliferation of supporting structures and destruction of the posterior layers of the retina. (3) The changes in the vessels in the outer layers of the retina are in the nature of excessive dilatation, almost amounting to a cavernous type, while others again show thickening of their walls. (4) There is no sign of inflammation. (5) The choroid has practically no share in the process. In some cases, after a time, the hæmorrhages may cause a little irritation, and thus the choroid may become slightly thickened and infiltrated over a small area, and a little pigment migration takes place, but this pigment does not appear to have been visible with the ophthalmoscope.

Now I think we should restrict the name "Coats' disease" to those cases which conform in every particular to the ones he described, and not pick out one special feature, such as a deep-seated exudate, and attempt to settle the diagnosis of a particular case on this appearance alone.

It is only by taking into consideration the accompanying clinical signs and symptoms, and then watching, often for a long time, the ophthalmoscopic changes and subsequent behaviour of these exudates, that we can come to definite conclusions regarding their cause.

No doubt it is difficult to detect ophthalmoscopically any actual difference in the appearance between a post-retinal exudate originating from the posterior part of the retina and one originating from the choroid, because they are practically in the same situation and show many points of similarity, and when the deposit is caused by the same kind of extravasation, the degeneration changes in an organized blood clot or albuminous exudate exhibit identical characteristics, but it does not necessarily follow that the source of the exudation of fluid is the same in all cases. Coats himself made a great point of this in his original paper.

In the first place, since the white deposits are widespread, often multiple, and ill-defined, besides being usually situated away from the macula, I should hesitate to describe a single exudate with a well-defined border, occurring at the macula, however similar in ophthalmoscopic appearance, as an example of Coats' disease.

It is true that in the third case described in his original paper there was a deposit at the macula, but in this case there were additional large areas all over the fundus, the retina was totally detached, and the eye was removed five years after the defect in vision was first noticed; thus giving ample time for the extension of the exudation. And yet I have heard cases of a single exudate at the macula described as Coats' disease.

Then again, the disc itself is generally normal, with well-defined edges, but the retinal vessels, although affected in some way, show the changes less noticeably on the disc itself than in other parts of the fundus away from the disc. Therefore, if in any individual case the disc and retinal vessels in the whole of their course were perfectly normal, I should consider this an additional reason for rejecting the diagnosis of Coats' disease.

At the clinical meeting of the Section in December, 1931, in a case described as one of Coats' disease there was definite papillœdema with the characteristic appearance of the retinal vessels on the disc seen under such conditions, and a patch of white exudate some little distance away from the disc on the nasal side, which was probably a hæmorrhage; also the patient was young.

It might be said, possibly with some reason, that this is really an early case of Coats' disease, and that the exudate of blood would become larger and more extensive later on. I understand that the condition has already existed for some time, and the appearance is far from being typical at present.

Naturally, the most convincing proof is the pathological and histological one, but, as this is, unfortunately, so often denied us, we are forced to rely on the clinical evidence. At the same time, much valuable pathological work has already been published from time to time by competent observers, whose conclusions have not been disputed.

When Coats wrote his paper, he dealt exhaustively with all the literature which he could collect at that time from all countries, and amongst the material he found many cases similar to his own and others dissimilar, but the actual type which he described is in a class by itself.

A certain amount has been written since then, but the literature connected with these deposits and allied subjects appears under so many different names and titles that the essential points are difficult to unravel, yet we shall find that the information contained in the papers is helpful, even if it is sometimes a little ambiguous.

Scarlett, in a paper on "Circinate Retinitis" in the *American Journal of Ophthalmology* for August, 1929, shows a coloured drawing representing a deep hæmorrhagic exudate at the macula surrounded by a ring of smaller exudates (circinate retinitis), but he pays more attention to the microscopical pathology of the outlying exudates than to the mass in the macula, which is probably the cause of it all.

Lloyd, in the same Journal for 1928, in a paper entitled "Fundus conditions requiring differentiation from intraocular tumour," discusses some inflammatory, as well as non-inflammatory, exudates; and in regard to the latter, after describing Coats' disease, he refers to one form of massive exudate in the macula region in the following words:—

> "The latter group (i.e. in older patients) differs somewhat from the rest of the cases, in that the macula area is the location of the lesion. On one side they resemble (or originate in) retinitis circinata, and on the other, Kuhut's disciform degeneration of the macula."

He also speaks of "retinitis circinata in one eye and Coats' disease in the other," and of "retinitis circinata passing into typical exudative retinitis," etc.

Kalt, in an article on "Exudative Retinitis without Vascular Changes" in the *Annales d'Oculistique* for November, 1930, describes a case, with microscopical examination, of massive exudate covering the disc and macula in a woman aged 73 whose eye, a myopic one, had been removed on account of inflammatory iritic complications following cataract extraction. He states definitely that the choroid was absolutely normal, and that the exudate was entirely confined to the retina and of the type of a disorganized hæmorrhage. He also thinks it worth while to insist that his case is a separate type from that described by Coats.

Junius, on the other hand, contributes a paper on "Exudative Retinitis with Vascular Change" in the *Klin. Monatsblatt für Augenheilk.* for 1931.

Much of the literature recently published is in a similar strain, clearly showing that many writers consider that every form of exudate found in the retinal layers must of necessity be derived from the retinal vessels.

However, Holloway and Verhoeff in an article on "Disc-like Degeneration in the Macula" in the *Archives of Ophthalmology* for February, 1929, definitely proved by microscopical examination that the deeply situated mass at the macula in an elderly patient was due to disease of the choroidal blood-vessels.

In the *Transactions of the Ophthalmological Society*, vol. xlviii, Mayou reports the pathological details in a case of widespread exudate with a retinal detachment. He found that the posterior layers of the retina were adherent to the choroid, the venæ vorticosæ were thrombosed, and the detachment had occurred between the anterior and posterior layers of the retina. He thus proved that the source of the hæmorrhage was from the choroid. I am, therefore, surprised that his paper was

entitled "Coats' Disease," as in Coats' disease the choroid is always unaffected and normal.

But the particular type of white deposits which I wish to discuss are those occurring in the macular region and occupying practically the whole of this area. They often have a well-defined border and are raised above the level of the rest of the fundus, while the retinal vessels show no visible change in any part of their course and the disc is normal. Of this kind of deposit, there are three chief varieties, viz.: new growth, simple serous exudations, and blood extravasations, which at certain stages often look very much alike. With regard to new growths, the usual aids to diagnosis are the occurrence in early stages of a small swelling, which gradually increases in size under observation, while at a later stage—as was pointed out in a case described by Mr. Neame at the meeting held in January—vessels of new formation make their appearance over the swelling, and an ordinary detachment of the retina may be discovered at varying distances away from the tumour itself. Also, though by no means always, there are deposits of pigment somewhere in the neighbourhood of the growth, perhaps only a fringe visible along one edge.

On the other hand, the simple serous exudates and blood extravasations occur suddenly, attain their maximum amount of swelling in the early stages, then slowly subside under observation, and later undergo changes, both ophthalmoscopically and histologically, of various kinds.

It is these last two varieties which always give rise to the greatest divergence of opinion, because the changes bring about so much alteration in the ophthalmoscopic picture, according to the stage at which any individual case is first observed, that we fail to recognize the possibility of many of the exudates starting in the same way, and thus a separate diagnosis is suggested for every new clinical picture, and many of them receive the name of Coats' disease.

However, I am sure it will be generally agreed that vascular changes of some kind are responsible for the white exudates at the macula.

In the *Transactions of the Ophthalmological Society*, vol. xlvi, under the heading of "Senile Macular Exudative Retinitis," Davenport gives an excellent analysis of the clinical characteristics in a series of cases in which exudates at the macula were found in elderly people, and, while deploring the absence of pathological proof, brings sufficient evidence forward to demonstrate that such cases belong to a different category from those described by Coats. He, however, endeavours to establish some direct connection between the occurrence of these exudates and the condition of the retinal vessels, and in some of his cases he records definite arterio-sclerosis, while in others the vessels were found to be normal. As all but three of his patients were over seventy years of age, it is not surprising that in some of them there were sclerotic changes in the vessel walls, and in all probability the choroidal vessels, which are usually invisible, were affected in a similar way.

In studying diseases of the choroid, one cannot help being struck by the fact that fundus conditions due to disease of the choroid blood-vessels may be in existence for many years in the presence of perfectly normal retinal vessels, while in other cases the reverse is the rule; yet again both systems may be involved together in sclerotic changes of their vessel-walls. Indeed the independent behaviour of these two systems, so near to each other and yet each so anatomically isolated, has always been a matter of surprise to me.

Now, as regards the vascular system from which such localized and well-defined exudates arise, it seems to me most unlikely, if the retinal vessels are normal throughout their whole course, even allowing for the possibility that dilatation of the terminal branches in the posterior layers might take place in the presence of normal vessels elsewhere, that such a massive exudate should occur in a region where the vessels of the retinal system attain their smallest dimensions and finally

cease altogether at the fovea. In this connection it might be well to press the point that the fovea is always included in these exudates.

The only other system from which such an exudation can arise is the choroidal; the vessels of the choroid at the macula are larger and more numerous than in most other parts of the fundus, and, therefore, more likely to give rise to massive exudate when they are affected. Moreover, there are reasons for thinking that the vascular supply of the macula is very isolated, thus accounting for the well-defined border.

Now, if we can agree that massive white exudates of somewhat similar appearance, and showing similar pathological changes, may arise from either the retinal or the choroidal system, it will go a long way towards reconciling the apparently divergent views regarding their origin.

At the same time, I am of the opinion that the particular type of white or yellowish-white deposit in the macular region to which I have referred is more likely to be of choroidal than of retinal origin, and I consider this diagnosis is supported by the clinical and ophthalmoscopic data in a great many cases, and should, therefore, not be confused with Coats' disease.

It will naturally be asked: "What are we to call such deposits?"

I think we must be content with the term "post-retinal exudate" or "post-retinal hæmorrhage," without committing ourselves to any particular system from which the fluid is derived, until changes in the ophthalmoscopic picture or a pathological examination make a more accurate diagnosis possible, but we can add also the clinical points in favour of one vascular system or the other, and in this way express a decided opinion on a case without putting it in one definite class, which has already been supported by pathological proof.

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Discussion.—Mr. M. S. MAYOU pointed out that Coats, under the term of "massive exudation in the retina," described three different classes of cases. The first was the one similar to the cases which Mr. Hepburn had shown this evening—a change occurring in and about the macula in old people—and was thought by Coats and also by himself to be due to constant repeated hæmorrhage into the retina from the retinal vessels, causing massive exudation. The second class of cases described by Coats were in young people, similar to the one which the speaker had described (*Trans. Ophthalmological Society*, 1928, xlviii) in which the exudate was primarily derived from the choroid and ended in glaucoma, following thrombosis of the venæ vorticosæ. The third class of case which Coats described was probably the same as Lindau's disease, which was not recognized at that time, although a case had been published by Treacher Collins.

The question was whether the name of Coats should be attached to the first disease, or to the first two diseases described by him, as they have an entirely different pathology.

Mr. HUMPHREY NEAME said it was known that retinal hæmorrhages might occur without apparent arterial disease of the retina, possibly from some chemical causes. So that the absence of obvious retinal vascular disease did not exclude the possibility of the origin of these hæmorrhages being retinal, and he did not think that the presence of pigment in the retina due to pigment epithelium proliferation, necessarily showed that the origin of the trouble was choroidal.

Mr. E. WOLFF said that one point which seemed peculiar about exudates at the macula—in the so-called macular exudative retinitis—was their shape which in all cases tended to be more or less oval. There was nothing in the anatomy of the choroid which would give them that shape, but the area occupied by Henle's fibre layer corresponded to it: he thought therefore that they must originate in Henle's fibre layer.

Mr. HEPBURN, in reply, said that he had carefully read Mr. Mayou's paper; Mr. Mayou and he (the speaker) were thinking of two different things. The cases which Coats had described pathologically were cases of Coats' disease. While admitting that Mr. Mayou's case showed some points of similarity to one or two of those mentioned by Coats in his reference to the literature, it did not correspond to any of the cases which Coats himself examined.

The point raised by Mr. Humphrey Neame was a doubtful one. Mr. Neame was a pathologist, whereas he, Mr. Hepburn, was not. He was not quite sure that pigment could be disturbed in purely retinal conditions but if so, he thought such disturbance must be rare.

Traumatic Periostitis of Orbit: Further Note on Case shown November 13, 1931, as one of Dacryoadenitis.[1]—JOHN FOSTER, F.R.C.S.

A semilunar incision was made around the outer edge of the orbit and a wedge of the swelling was removed. An area of bone was found on the outer margin of the orbit but there was no trace of a foreign body.

Primary suture; uneventful healing; no trace of swelling one month later.

0·5 c.c. of an emulsion of removed tissue injected into guinea-pig. Pathological examination of guinea-pig three months later: No evidence of tuberculosis.

Histological examination of tissue.—Infiltration with large lymphocytes and plasma cells; a few giant cells, similar to those found in chalazion.

No tubercle bacilli shown by Ziehl-Nielsen's stains. The condition is apparently periostitis of the orbit, caused by a blow from a tennis ball.

1 See *Proceedings*, xxv, 473 (Sect. Ophthal. 15), "? Tuberculosis of Lachrymal and Accessory Lachrymal Gland."

Section of Surgery.

President—Mr. C. H. FAGGE, M.S.

[*March* 2, 1932.]

The Results of Treatment of Injuries about the Elbow.

By N. L. ECKHOFF, M.S., F.R.C.S., and D. W. C. NORTHFIELD, M S., F.R.C.S.

THIS investigation was stimulated by an impression gained that the results of treatment of injuries about the elbow are, on the whole, not encouraging. Much has been written about the immediate treatment of such injuries (an excellent discussion was held upon "Minor Injuries of the Elbow" at a meeting of the Section of Orthopædics two years ago [1]), but little evidence has been forthcoming about the true end-results.

It is to be deplored that routine follow-up clinics are not more systematically organized in this country. Presumably the chief difficulty lies in the expense of the increased secretarial and medical staff that would be necessary, coupled with the enormous numbers that already crowd the out-patients' departments (at Guy's Hospital amounting to half a million annually).

In the absence of such organization our work has been extraordinarily difficult and slow. We began by studying the reports of all the patients in this group that were admitted to Guy's Hospital in the five years 1926-1930, inclusive, abstracting the salient features. We then wrote to them in batches asking them to come to see us. We had to write a second time to many of them and finally sent a questionnaire to the most refractory. We found 110 cases, and saw, or had replies from 88, exactly four-fifths of the total.

The year 1931 has not been included because it is felt that improvement may still be taking place in some of these cases. It should be pointed out that these cases have come under the care of many different surgeons (to whom we are indebted for permission to use the material) and that therefore the same principles of treatment, particularly after-treatment, have not necessarily been applied to all of them.

For the sake of comparison we next selected patients falling into this category who attended the Fracture Out-patient Department during one year, 1929, and circularized them. Out of 77 we have been able to investigate 59, again practically four-fifths of the total. It would obviously be desirable to investigate all the out-patient cases in the five-year period, and we may be able to do this later, but the results of treatment are so good in this group, that it is unlikely that any further evidence will be forthcoming. The cases that are likely to be difficult are always admitted to hospital.

We realize that the numbers are small, and we have therefore not attempted to draw any conclusions in terms of percentages, which are always apt to be fallacious, except in a very large series. But we hope that something may be learnt as a result of this investigation.

The cases fall into the groups set out in the table.

TABLE.—NUMBER OF CASES AND RESULTS OF TREATMENT.

Fracture	In-patients, 1926-30						Out-patients, 1929	
	Open operation			Manipulation				
	No.	Good		No.	Good		No.	Perfect
Humerus—								
Supracondylar	4	1	...	15	11	...	20	17
T-shaped	1	0	...	3	0	...	—	—
Capitellum	5	4	...	7	3	...	1	1
Ext. epicondyle ...	—	—	...	1	?	...	1	1
Trochlea	2	0	...	—	—	...	3	3
Int. epicondyle ...	4	4	...	1	1	...	6	4
Intra-articular ...	4	2	...	—	—	...	—	—
Radius—								
Head and neck ...	12	7	...	2	0	...	16	12
Ulna—								
Olecranon	15	15	...	3	2	...	7	7
Dislocations	—	—	...	9	8	...	5	5
Totals ...	47	33		41	25		59	50

It must be remarked that the nomenclature adopted in referring to fractures of the condyles and epicondyles is frequently rather loose. The term "condyle," which incidentally has not been used in the textbooks of anatomy in this connection for about thirty years, refers to the articular end of the bone, i.e., the capitellum or the trochlea, and the term "epicondyle" refers to the extracapsular portion of the bone, whether it be on the inner or the outer side. We have been careful to make this distinction.

RESULTS.

The out-patient cases.—There were twenty cases of supracondylar fracture, and seventeen have perfect results. Two have some limitation of extension, and one has limitation of flexion of a mild degree in addition. This last case came for treatment six weeks after the injury. One case has slight varus deformity, and it appears on examination as though the external epicondyle were displaced anteriorly, which may account for this (see Discussion later).

There was only one case of fracture of the capitellum, one of fracture of the external epicondyle, and three of fracture of the trochlea. All these have now perfect results. There were six cases of fracture of the internal epicondyle, one having in addition a fracture of the head of the radius, and two having evidence of ulnar nerve involvement at the time of the injury. Four have now perfect results, one has some limitation of flexion, and one limitation of flexion and extension. In none is there any evidence of a nerve lesion.

There were sixteen cases of fracture of the head or neck of the radius (one having, in addition, a chip off the external epicondyle). Twelve of these have perfect results, one has limitation of flexion, two have some limitation of flexion and extension, and four have limitation of supination. In three there is slight pain with heavy work.

Seven cases of fracture of the olecranon were seen (one with a chip off the external epicondyle). All have perfect results.

Five cases of dislocation were seen, all with perfect results. It should be pointed out that at Guy's dislocations are not sent to the Fracture Out-patient Department, unless a fracture is present or suspected. A few are admitted, as will be seen later, but most are treated in the General Surgical Out-Patient Department.

It may therefore be said that the results in the out-patient group are in the main very satisfactory, and in all the function is very good. Attention should however be drawn to two points: (1) The ulnar nerve injury associated with fractures of the internal epicondyle. Platt [2] has described this in a series of cases, and thinks it is due to direct injury of the nerve, whereas Watson Jones [1] ascribes it to indirect violence, by stretching. (2) The limitation of supination in four out of sixteen cases of fractured radius.

THE IN-PATIENT CASES.

Supracondylar fractures of the humerus.—Nineteen cases were examined, two with a dislocation as well as a fracture.

The general treatment was to manipulate under general anæsthesia, on one or more occasions. In four cases only was open reduction found necessary. In one of these (a fracture of eighteen months standing, with varus 20° and backward angulation) osteotomy was performed, whilst in the other three the fragments were levered into position. The results of these four cases are: One has almost full movements, with a slight degree of varus deformity; the other three have limitation of flexion to 90°, one also having limitation of extension by 45°. These three have marked varus deformity. The functional result in all four is good, the patients being young, and not noticing any disability.

From the anatomical result in these four cases operated on, one might be inclined to condemn open operation at once. But it must be realized that these were all cases with much swelling and severe displacement, and it is certain that without operation the reduction and the result would have been less satisfactory,

In the fifteen cases (two with dislocation) treated by manipulation only, the results are: One has marked varus deformity, two have slight varus and one has slight valgus deformity, and one has slight valgus and limited extension (by 30°). Four were adults (ages 18, 24, 53, 76), and in these, three had limitation of flexion and extension, the fourth, the oldest of them all, being very satisfactory. Two others indicate by letter limitation of flexion and extension. The remaining four have very good results, In all fifteen cases the power was good.

T-shaped fractures.—Four cases were examined, all adults (ages 20, 42, 54, 69). In one, excision of the fragments was performed. A range of movement of only 30° remains, though rotation is unimpaired. The patient finds it difficult to wring clothes, and has some pain along the ulnar side of the arm. In the three others, manipulation was relied upon. All have 90° of movement only, with some limitation of rotation, and one has some varus. In one only is the power full.

Fractures of the external condyle, i.e., the capitellum.—Twelve cases were examined (one with dislocation). Operation was necessary in five, and the fragment was replaced in one case, excised in the others. In one of these, a woman aged 35, only 60° of movement remains and the power is fair. In the others there is very slight limitation of flexion or extension with full power. Excessive lateral mobility is noticed in one. In the seven cases treated by manipulation, four show limitation of extension (from 2° to 20°) while three have full movements and all have very good function.

Fracture of the external epicondyle.—One case was noted in a patient admitted for a dislocation, where there were a few chips off the epicondyle. The dislocation was reduced. The patient's reply to the questionnaire was vague, and he did not attend after subsequent requests.

Fractures of the internal condyle, i.e. the trochlea.—Two cases were treated by open operation. In one, in which an ulnar nerve palsy had developed, and the fragment was replaced subsequently, the palsy has disappeared, but there is limitation of extension by 20° and the power is diminished. In the other (aged 35), where the fragments were partially excised, there is now only 45° of movement, limited pronation, but good function.

Fractures of the internal epicondyle.—Four cases were investigated in which the fragment was excised for evidence of or fear of involvement of the ulnar nerve, or for limitation of movement. In all, full movement and power has resulted. One case was seen associated with dislocation and a cracked olecranon. The dislocation was reduced, and the result is very nearly perfect.

Intra-articular fractures of the trochlea and capitellum.—Four cases of this peculiar injury were seen. In two the fragment was replaced and kept in position

by flexion, and the results are perfect. In one the fragment was replaced, but a small chip was left undetected, and this subsequently gave rise to myositis ossificans. The mass of bone was later removed, but there is now only 90° of movement, but good power.

In the last case the fragment was excised, and the patient developed a tourniquet paralysis (reported by one of us elsewhere) [3]. This recovered in due course, but hampered an early return to activity, so that it is not surprising that flexion and extension are still limited.

Fractures of the head and neck of radius.—Fourteen cases were investigated, two with dislocations also. In three the head of the bone was replaced. One has an excellent result, one has limitation of flexion and extension, due to myositis ossificans, and one (in whom the operation was performed seven weeks after the injury) has complete loss of rotation.

In nine the head of the bone was excised. In one of these (in whom the operation was performed for loss of rotation eight weeks after the injury) there is still complete loss of rotation. In another (aged 59), in whom there was also a fracture of the olecranon requiring fixation, there is limitation of flexion, extension and supination, with valgus deformity and excessive lateral mobility, and a generally weak arm. Three have excellent results, but most of the others have slight limitation of flexion, extension or supination. In two with dislocation, the dislocation was reduced, and no operation was performed. One has limitation of flexion and extension, whilst the other (a case in which there was marked effusion at the time of the accident) has developed myositis ossificans.

Olecranon.—Eighteen cases were investigated, three of which were considered too old or unsuitable for operation. The remaining fifteen had the fragment replaced either by wiring or by a screw driven through the olecranon. About half the cases have slight limitation of flexion or extension, but all have good power.

Dislocations.—Nine cases were found in this series (though it should be noted that this injury is usually treated in the Surgical Out-patient Department). Eight have excellent results. In one, a girl, sent to Guy's Hospital with a diagnosis of "fracture-dislocation" (reduced outside), there was no X-ray evidence of fracture, yet myositis ossificans in severe degree developed, and there is now, after many operations, only 60° of movement, but excellent power.

Discussion.

In the supracondylar fractures of the humerus the bad results in all groups show either a varus deformity or a diminution of flexion or extension. These are mostly cases with severe displacements at the outset. It appears to us that these deformities are largely due to inaccurate apposition of the fragments, and we can recognize three major displacements: a backward displacement of the lower fragment as a whole; an internal rotation of the lower fragment, so that the internal epicondyle points still further backwards; and a rotation of the lower fragment into a varus position, so that the internal epicondyle is displaced upwards. We have made some attempt to discover the relationship of these displacements to the bad results by taking stereoscopic pictures of all of them. The interpretation of these pictures is difficult at this stage owing to the remodelling of the bone that has taken place. We feel that if stereoscopic pictures were made a routine in all these fractures immediately after manipulation, the displacements mentioned would not be lost sight of. When the arm is placed in flexion, the usual position after reduction, only lateral pictures can be taken and the antero-posterior displacement is the only one that can be studied.

Posterior displacement is evident in all the bad results. Obliquity of the line of fracture is the chief factor which makes for difficulty in maintaining reduction.

Internal rotation and varus deformity of the lower fragment are intimately associated, and there is an ever-present tendency for these deformities to occur.

Any degree of internal rotation will immediately allow the inner part of the lower fragment to ride up behind the upper fragment, thus producing the varus deformity. We are able to show one of a pair of stereoscopic pictures of a recent fracture, where this displacement is noticed. We have also made an attempt to reproduce the fracture artificially. The same appearance is noted in the X-rays. The increased width of the lower end of the upper fragment in the X-rays is clearly due to the rotation and cannot be ignored, as suggested by some observers. It was also noticed how much the inner end of the lower fragment could be displaced while the outer end was still in relatively good apposition.

Böhler [4] has stated that the pronator teres plays an important part in causing an adduction or varus deformity of the lower fragment when the forearm is placed in supination. But if it is realized that the pronator teres arises for some little distance up the supracondylar line, and that these fractures are usually immediately above the epicondyles, it follows that the muscle cannot affect the position of the fragment to which it is so little attached. Further, it is doubtful if in the living any muscle can act singly in bringing about a change in the position of a fragment.

A word about manipulation. In the first place this should always be carried out at the earliest possible moment and on the X-ray table, so that the elbow can immediately be screened and further manipulation can be carried out until a satisfactory result is obtained. The method in common use of manipulating in the theatre and taking an X-ray picture at leisure is fatal, for in these children bony adaption and repair takes place so rapidly that the golden opportunity for exact anatomical reposition is lost. A case was recently seen by one of us (N.L.E.), where in a child, aged 2½, with such a fracture no amount of ordinary force would move the fragments after five days. We are indebted to the President of this Section for instilling into us the value of manipulation on the X-ray table.

The fragments should be brought into place by first disempacting, applying traction in the extended position, keeping in mind the carrying angle and tending to exaggerate abduction in view of the tendency of the lower fragment to ride up on the inner side, when with pressure of the thumbs the fragments can be pushed into place. Better purchase can be obtained with the thumbs if the upper arm be brought up to be perpendicular to the table, as described by Paton [5]. Too early flexion is frequently the cause of difficulty in proper reduction. Most authorities [6, 7] stress flexion as an important element in aiding reduction. One [8] goes so far as to recommend what he calls "hyperflexion," stating that "the position of hyperflexion *actively* reduces and holds the fragments in position." This we believe to be a very dangerous statement. If there has been complete reduction, the tone of muscles—flexors, as well as extensors—is such as to keep the fragments in place through a relatively wide range, as can be demonstrated on the X-ray table.

"Ischæmic" contracture (so-called) probably does not occur if proper reduction has taken place. We have evidence now that this is due to venous rather than arterial obstruction (Middleton) [9], and therefore the principle of imagining that the flexed position will reduce the fragments and that the presence of a radial pulse will prohibit this contracture is ludicrous. Sometimes excessive swelling will be an indication for open operation (as in the case recently described by Flemming [10]) to guard against this dread evil.

The wisdom of open operation in general must now be considered. It is evident that operation of itself does not spell success. Manipulation either by open or closed method undertaken at an inopportune moment will lead to unnecessary injury to soft parts and excessive callus formation. We fully recognize that many cases will get a good functional result, though the anatomical reposition is imperfect. But when it is abundantly clear from the first that manipulation of

itself is unable to overcome the displacements mentioned above, an early decision to operate should be made. After the first two or three days further manipulation or operation will lead to an even worse result.

We have not stressed sufficiently the damage that takes place in the soft parts. This is in proportion to the original violence, and to any superadded at the time of manipulation. We have shown X-rays of cases of myositis ossificans, and all of these have been accompanied by much swelling. We have indicated that great swelling may predispose to contracture. Much swelling about the fragments will obviously lead to much fibrosis in the soft parts. For these reasons, in addition to those mentioned above, early operation, with cautious return to active movements, should always be considered in cases of this type. In fractures of the epicondyles there is no need to interfere except where the fragment has, through laceration of the capsule, entered the joint. It may then be excised, or occasionally, pinned in place.

In fractures of the capitellum or trochlea, with displacement, the result to be anticipated is only fair. Excision or replacement of the fragment should be performed, depending on the degree of separation discovered at open operation. In T-shaped fractures the results are very bad. This is common knowledge, and is not surprising if the intricacy of the elbow-joint is remembered [1 and 2]. The elbow-joint is not a simple hinge-joint, and full movement depends upon the coronoid and olecranon processes of the ulna fitting into fossæ in the humerus in full flexion and extension.

In fractures of the olecranon the results are very good. Open operation in young subjects will shorten the time of convalescence, but treatment in extension in old subjects is very satisfactory.

The results of dislocation are also excellent, but a note of caution should be sounded to be on the look-out for small detached spicules of bone, and in cases with much swelling very slow return to movements advised.

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Thoracic Exposure of the Diaphragm and Lower Œsophagus.

By T. Holmes Sellors, M.Ch., F.R.C.S.

When exposing any organ in the thorax the most careful attention must be paid to the actual opening and closure of the chest. Where possible the operation will be transpleural in preference to any other route and consequently the production of open pneumothorax is inevitable and plays considerable part in the technique of the operation. The physiological disadvantages of an open pneumothorax may be overcome by differential pressure anæsthesia.

The left side of the chest is the side of choice. Before contemplating operation, the question of preliminary artificial pneumothorax should be considered in view of the advantages gained. The lung retracts from the site of the incision; if adhesions are present they can be detected by X-rays instead of coming as an unpleasant surprise at the actual time of the operation, and, above all, shock is reduced. It has been my practice while working for Mr. Gordon-Taylor to induce artificial pneumothorax a week before the prospected operation and to start with an initial volume of air which is considerably in excess of that commonly used in pulmonary tuberculosis. From 500 to 700 c.c., followed in about a day's time by from 1,000 to 1,500 c.c., has

given rise to no ill-effects and sometimes another refill the day before operation has been necessary. On account of the liability of certain patients to acneform eruptions, it is advisable to begin cleaning the skin several days before operation.

The actual induction of anæsthesia is occasionally difficult and prolonged on account of the loss of ventilating surface, and if the patient is at all emphysematous it may be difficult to obtain a sufficient depth of anæsthesia for convenient passing of the intratracheal catheter for the differential pressure anæsthetic. On the operating table a pillow should be secured under the healthy side to obtain arching of the chest at the site of the incision. Sometimes the head slightly lowered will enable the collapsed lung to fall out of the way, but in cases with diaphragmatic hernia the reverse attitude may be necessary.

Exposure really determines the whole success of the operation, as there must be sufficient room for the surgeon to work within the depths of the thoracic cavity. The skin incision may be satisfactorily drawn postero-laterally along the line of the eighth and ninth ribs, and if curved a little at the posterior end, further exposure can be obtained. Opening the chest by incising between ribs and applying a powerful rib-spreader may suffice, but it is better to remove 8 to 10 in. of either of the ribs mentioned and then to retract strongly. The rigidity of the ribs really determines the access. If further room is required it is possible to divide ribs so as to enhance the action of the retractor. Resection of lengths of several ribs over a short area, with outward retraction, constitutes the approach which was, I believe, originated by Enderlen. Division of several ribs with upward retraction allows them to ride over each other and forms the method of "shingling" which has been advocated by Lilienthal. Shock may be incurred by an extensive incision, but is more than compensated by the speed and ease of manipulation. Speed in this class of work is undoubtedly an important factor and the best results have been obtained when operations have been completed within fifty minutes. Within the thorax no time should be wasted and all traction on the mediastinum and adjacent structures must be avoided. Bleeding contributes largely to shock and if perfect hæmostasis is not secured there is the risk that (after the chest is closed) the lowered pressure of the pleural cavity will encourage oozing of blood rather than help to control it.

Within the thorax the picture is almost constant, and I would draw attention to the phrenic nerve as it lies on the pericardium. Paralysis of the diaphragm by crushing the nerve in this situation contributes largely to the ease of the operation and the peace that reigns in some cases after the turbulence of laboured respiration is often dramatic. If continuity is not destroyed it is probable that the nerve will regenerate in four to six months, but our experience with phrenic avulsion tells us that inconvenience from the absence of one half of the diaphragm is negligible.

The actual intrathoracic procedure depends largely on the individual circumstances of the case. With diaphragmatic hernia, once the sac is opened and adhesions are divided the abdominal contents can be easily replaced and the muscular edges of the opening can be dissected free. Overlapping of the gap with two layers of interrupted sutures, or in some instances with fascia lata, suffices to bring about satisfactory closure in nearly every case, particularly as the strain of the diaphragm is not present.

Exposure of the œsophagus is made by incising the mediastinal pleura and careful dissection and identification of the loose muscular coats; occasionally the passage of a bougie simplifies the procedure. Mobilization of the organ is effected by dividing the paralysed diaphragm and bringing the stomach into the thorax, and if operation is to be extended various types of anastomosis are available, the general principle being to afford a long serous tunnel for the muscular coating of the œsophagus.

If respiratory distress occurs the operation may be stopped while the lung

is inflated several times, and if there is much shock intravenous saline or transfusion may be given.

Closure of the wound should be exact, but the end of an operation is often hurried and details are sacrificed so long as an air-tight closure is effected. When the wound is closed the lung should be expanded as fully as possible and a minimum surface of raw pleura left on the inside of the chest. The parietal pleura does not form a good hold for stitches, and as the ribs have been retracted heavily during the operation, it is not easy to approximate the cut edges unless one or two stout sutures are run round adjacent ribs subperiosteally. These pericostal sutures constitute an effective method of closure in emergency, but they should be supplemented by pleural and muscular layers of stitches. Continuous sutures make a better closure, but interrupted stitches are useful in taking strain. The actual closure of the pleural cavity should be performed with the lung in the position of fullest expansion, as early inflation of the lung favours rapid convalescence. Some effusion after opening of the chest is inevitable, and the treatment of this fluid is occasionally the source of difficulty. If left alone infection may follow if there has been much intrathoracic manipulation. The pleura should be kept dry, and to effect this two alternatives are possible. Daily aspiration gives good results, but the patient sometimes resents the interference, and the circumstances do not favour good aseptic technique; cases have developed infection as a result. Originally we used this method but have abandoned it for a system of closed drainage over the first few days. Through a small stab wound in the lowest part of the costo-phrenic gutter a little catheter may be placed (a flange, as may be produced by cutting off the tip of a de Pezzer, is advisable) and the tube clamped off before the chest is closed. The main wound is then closed and on the patient's return to bed the catheter is connected with a closed drainage apparatus such as White's. When the effusion has diminished the tube can easily be jerked out and the wound closed satisfactorily with a pad of dressing. I have never seen any ill effect after removing the tube.

Breathing exercises are a very important part of the after-treatment, for, as I have said before, early convalescence is promoted by rapid expansion of the lung. Inhalation of carbon dioxide has a remarkable effect in some cases and, short of distressing the patient, should be practised two or three times a day for a few minutes.

In conclusion, in the performance of any thoracotomy the actual incision in the chest wall demands considerable attention which is fully repaid by the improved access and speedy convalescence, and shock is undoubtedly reduced if preliminary artificial pneumothorax is used. Within the pleural cavity the ease with which the diaphragm can be paralysed should not be forgotten as an aid to the actual technical problem and the result.

Endothelioma of Lymph Nodes.

By R. S. Pilcher, F.R.C.S.

My object in introducing this controversial subject is first to describe some clinical and histological observations illustrating the distinguishing features of the disease, and secondly to demonstrate its identity with endothelioma of the nasopharynx. I am convinced that the disease is more common than is generally realized. Its recognition is important because it is, so far as I know, invariably fatal if not treated, and it is in its early stages that it may be to some extent amenable to treatment.

The cases which form the basis of this paper are collected from the records of University College Hospital for the last ten years. I have found some thirty cases which I believe to be examples of the disease, and from these I have selected

fourteen in which there is adequate histological evidence. In addition, five cases of endothelioma of the nasopharynx admitted during the same period have previously been reported by Gardham [1]. In the literature the best account of the disease as it affects lymphatic glands is that of Ewing [2], who does not, however, describe its manifestations in other parts. There are numerous reports of nasopharyngeal endotheliomata, the characteristic symptoms of which were described by Trotter [3] in 1911 and further by Gardham in 1929. As far as I am aware it has not been pointed out before that the majority of these nasopharyngeal tumours arise in the lymphatic tissue of the nasopharynx and are similar in their behaviour and histology to the endothelioma of lymph nodes described by Ewing. New [4], in an extensive review of the symptoms of nasopharyngeal tumours which he describes as mostly carcinoma or lymphosarcoma, mentions that in three of his cases a previous diagnosis of endothelioma had been made on biopsy of cervical glands. All observers of the nasopharyngeal type of the disease are agreed as to the common occurrence of so-called glandular metastases which are in some cases conspicuous before the primary growth gives symptoms or signs. That the primary manifestation of the disease is not necessarily in the nasopharynx but may be in the glands has apparently escaped consideration. I think the explanation of the varied clinical pictures is to be found in the observation that the disease does not start in a single focus and thence metastasize to neighbouring glands, but arises simultaneously in multiple foci tending to be concentrated in definite anatomical groups. These foci include any part of the body that is characterized by the presence of lymphatic tissue. The cases that I have collected show the incidence of the disease in the following situations: Nasopharynx, tonsil and pharynx, cervical, axillary, inguinal, iliac, lumbar and aortic glands and spleen. The high incidence of the disease in the nasopharynx is due in part to the large amount of lymphatic tissue in this region, and also, probably, to its exposure to infection, which seems to be a common precursor of the condition. Whatever the real nature of the disease, there is little doubt that any lymphatic tissue may be involved and that commonly it arises in multiple foci. In a case in which adequate material is available, it is possible to trace stages in the development of the condition in adjacent glands. There appears to be an essential change in the gland itself with no suggestion of cellular metastasis from adjacent foci. When the change has occurred in any one gland the endotheliomatous tissue behaves like a malignant growth, and although remaining confined within the capsule for a long time, finally escapes and infiltrates surrounding tissues. This infiltration of other tissues is followed by dense fibrosis which is seldom a marked feature in the glands. In the nasopharynx the lymphatic tissue is not encapsulated as it is in the glands, and it is this difference which probably accounts for the widespread infiltration of the structures at the base of the skull which is a constant feature of the disease in this situation and gives rise to its pathognomonic symptoms.

Clinically, the disease is characterized by tumour formation in lymphatic tissue and has no other constant feature. This being so, the nature of the tumours is of great importance. The tumours of glands are multiple, discrete, smooth, round or oval swellings of rubbery consistence. They are at first unattached to one another or to surrounding structures and may reach a large size before the disease transgresses the gland capsule. Later in the course of the disease the glands become matted together and tethered to surrounding structures. When the process escapes from the glands it infiltrates diffusely and gives rise to dense fibrosis. In an advanced case the whole part may be occupied by diffuse woody induration, in which, however, it may still be possible to recognize the outlines of glands. The skin is involved with other tissues, and although thinned, does not ulcerate.

The nasopharyngeal tumours behave in a similar way, infiltrating the submucosa widely but not ulcerating through. I have already mentioned that the glands are

affected by groups rather than singly, and in the majority of cases when the patient is first seen, at least one group is extensively involved. In many the disease has already spread to adjacent groups, while occasionally it seems to start as a generalized process throughout the lymphatic system. Wherever it begins, it tends to spread to other parts of the lymphatic system, but for the purposes of treatment it is convenient to differentiate two types, a local and a general, although many cases are intermediate between the two,

In the general condition of the patient there is remarkably little change even in the late stages. There is no fever, no cachexia and no change in the blood count in

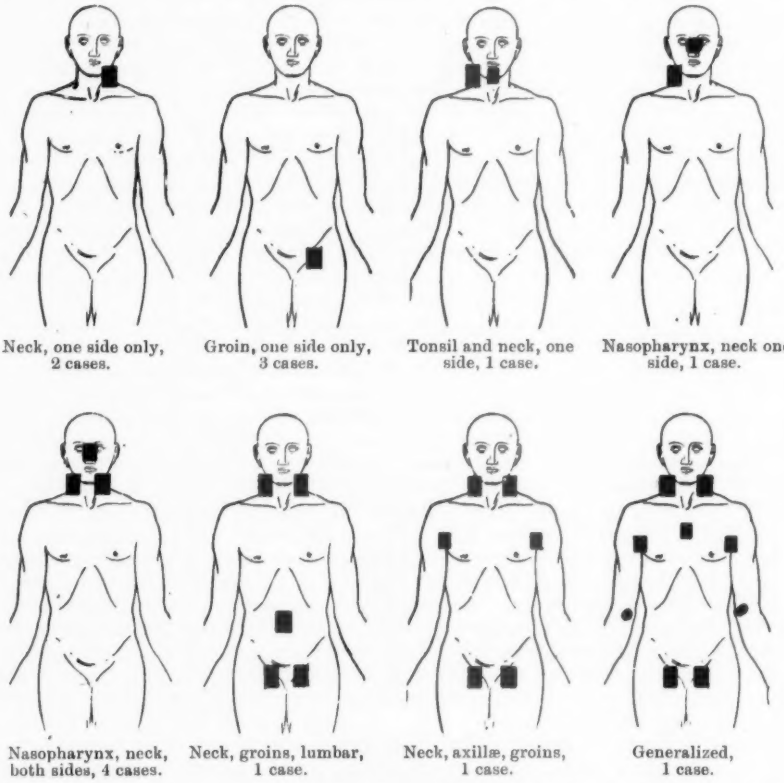

FIG. 1.—Distributions of lesions in fourteen cases of endothelioma at the time of the first examination of the patient.

the majority of cases, but in some cases observations are wanting on the last point. In only one case was enlargement of the spleen found and in that case, only as a terminal event; in no case was the liver found enlarged. In the majority of the cases in my series the final stages of the disease have not been observed and it may be that the changes noted above as being absent, actually occur more frequently, at any rate terminally.

The nasopharyngeal type of the disease has been fully described by Trotter and Gardham, and I shall not consider its symptoms in detail. The patient may consult a specialist for deafness, toothache or ophthalmoplegia, but when the disease produces these symptoms glands are usually enlarged and should arouse suspicion as to the true nature of the condition. Another sign which is of great value is weakness or paralysis of the palate on the same side as the symptoms. Apart from the special signs due to involvement of the nasopharynx, the course of the disease is as described for the type confined to glands.

The sex and age incidence of the fourteen cases of my series, and the five others previously referred to, is shown in the following table:—

Males	13 cases
Females	6 ,,
Aged 10 to 20 ...	1 ,,
,, 21 to 30 ...	3 ,,
,, 31 to 40 ...	4 ,,
,, 41 to 50 ...	5 ,,
,, 51 to 60 ...	6 ,,

The extent of the disease when the patients were first seen is shown diagrammatically in figure 1.

Seven of the patients are known to be dead and in five of these extension of the disease to other groups of glands was observed before death. One patient is untraced, six are still living, of whom three are at present free from signs of active disease, the longest being sixteen months after treatment.

The history given by the patients is very variable. In several a swelling had been present for several years and recently had increased in size, while in others for a few months only. In three of the nasopharyngeal cases there was a history of recurrent attacks of tonsillitis and in each tonsillectomy had been performed, but I can find no record of histological examination of the tonsils removed. In several cases the history suggests that the endothelioma supervened on a pre-existing infective process.

The response of the disease to irradiation may be of help in establishing the diagnosis. Full doses of X-rays can be given without any constitutional disturbance and are followed by shrinking or even disappearance of the tumours. Recurrence, however, usually occurs early, but is still sensitive and can be kept in check by repeated treatments. If the disease is localized it seems worth while to excise the affected glands and of the six cases living three have been treated in this way.

Owing to the frequent absence of distinguishing clinical features the histology of the disease is of great importance and may be the only means of diagnosis. It is, moreover, chiefly on histological evidence that the identity of the nasopharyngeal tumours with endothelioma of lymph glands is established. The tumours are composed of cells which for convenience I shall call endothelial cells without inferring that they arise from endothelium. The structure is variable and may be alveolar, plexiform or diffuse. In the alveolar and plexiform types a variable amount of lymphatic tissue survives between the areas of tumour, which takes the form of syncytial sheets in which outlines of individual cells are lost (figs. 2 and 3). Scattered about this syncytium are large vesicular nuclei variable in shape but having a very distinct outline, a clear but fine chromatin network and one or two nucleoli (fig. 4). The character of the nuclei appears to vary with the degree of activity of the tumour. In the diffuse type the lymphatic tissue is completely replaced by the tumour cells which have less cytoplasm, so that the nuclei appear more closely packed together. The nuclei are generally smaller and stain more deeply than in the syncytial type (fig. 5). In some cases a reticular structure is apparent, not unlike the reticulum of a normal gland, the cells of which resemble those of the endothelioma in many respects. By the silver impregnation method a network of reticular fibres can be

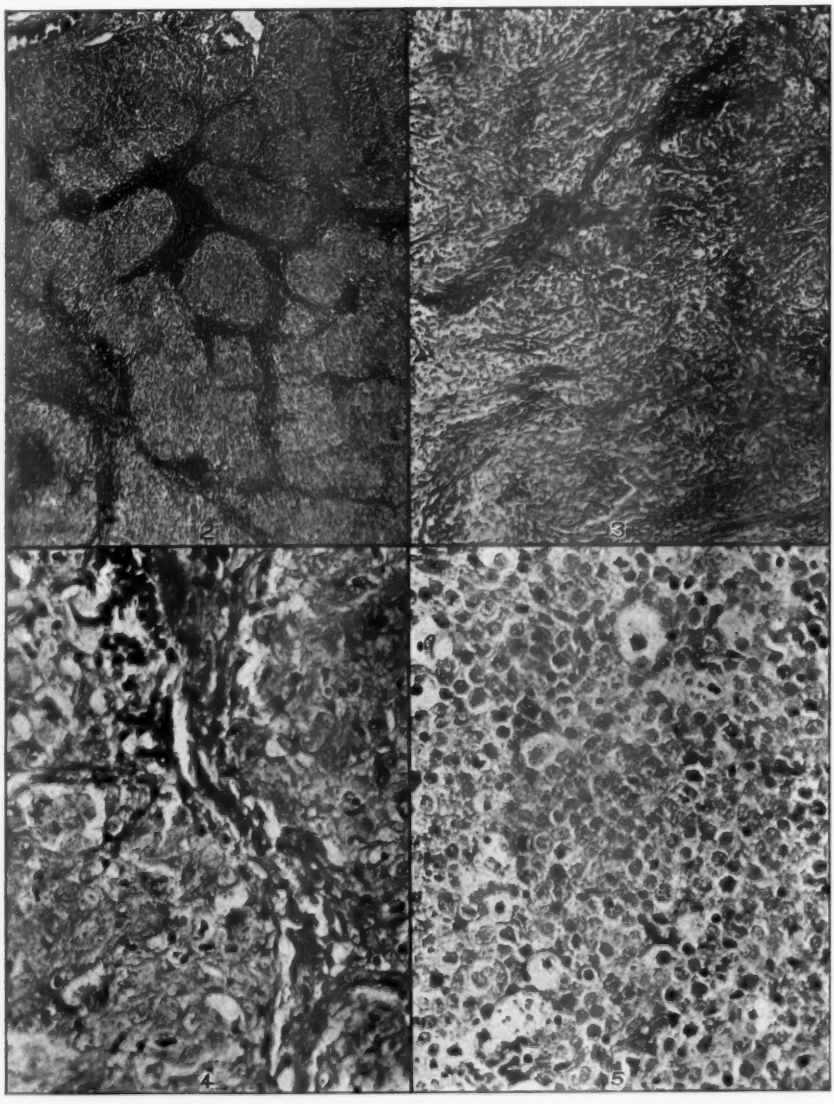

FIG. 2.—Epitrochlear gland from a case of generalized endothelioma of lymph nodes in a girl aged 19. Alveolar structure. × 180.

FIG. 3.—Cervical gland from a case of nasopharyngeal endothelioma in a man aged 26. Plexiform structure with some fibrosis. × 400.

FIG. 4.—Same section as fig. 2. Shows syncytium of endothelial cells with typical nuclei. × 800.

FIG. 5.—Inguinal gland from a case with multiple groups involved in a man aged 38. Shows diffuse type of growth. Nuclei more closely packed than in fig. 4 but having the same general appearance. × 800.

demonstrated in the sheets of endothelial cells. In both types numerous blood-vessels can be found, with well-defined endothelial walls, from which the tumour-cells may appear to be developing. When the tumour escapes from the gland capsule and infiltrates other tissues the endothelial cells change in appearance. The nuclei are smaller, stain more deeply, and are more variable in shape. In addition fibrosis, which may be absent in the glands, becomes a marked feature outside them. The appearance of some of the tumours suggests that the fibrous tissue may be formed by transformation of the endothelial cells themselves. An interesting feature that I have found in several cases is the presence in the tumour of rounded or oval spaces, which at first sight resemble fat spaces. No fat, however, can be demonstrated in them and under high magnification they resemble reticular spaces of normal lymph glands. All the histological appearances which I have described have been observed in both the glandular and the nasopharyngeal types of the endothelioma, showing the essential similarity of the two conditions.

In conclusion, I wish to thank members of the Staff of University College Hospital for permission to incorporate their cases in this paper—in particular Professor Choyce, who in addition has given me much valuable help and advice.

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Fractures of the Head of the Radius.

By C. W. FLEMMING, M.Ch., F.R.C.S.

THE fracture with which I am dealing is that of the articular surface of the radius only: it occurs almost exclusively in adults, in contrast to fractures of the neck, which occur more frequently in younger patients. Its importance lies in its frequency and in the very disabling—even crippling—arthritis that sometimes follows it. The cases on which this paper is based are twenty recently seen by me, out of a total of thirty which were treated at University College Hospital between two and five years ago. The series is admittedly small, but it includes every type of case, and furthermore I have been unable to find any reference elsewhere to any equal number having been examined so long after the injury.

It is usually stated that about 75% of these fractures are produced by direct injury, resulting from a fall on the elbow, and the remainder by a fall on the outstretched hand. With these figures, my series roughly agrees. It is difficult to see why two such diverse types of injury should produce the same fracture. In a classical case, the physical signs are as one would expect—namely, tenderness over the head of the radius, a small effusion into the elbow-joint and limitation of flexion, extension, pronation and supination; but a number of cases present very few signs and the fracture is only found in a routine radiographic examination.

It is on the X-ray findings that the course of treatment depends. The antero-posterior view is the important one, since the lateral view, except in cases of gross displacement, shows no signs of injury. The varieties are shown in the following photographs. The first picture (fig. 1, p. 50) shows the simplest case—a vertical crack with no apparent deformation of joint surface. The second (fig. 2) shows a further stage of bony injury, where the vertical crack is joined by a horizontal one, so that there is a completely detached fragment—but little deformation of the joint surface.

The third (fig. 3) shows a worse stage of the same injury—where there is considerable depression of the outer portion of the articular surface.

FIG. 1.

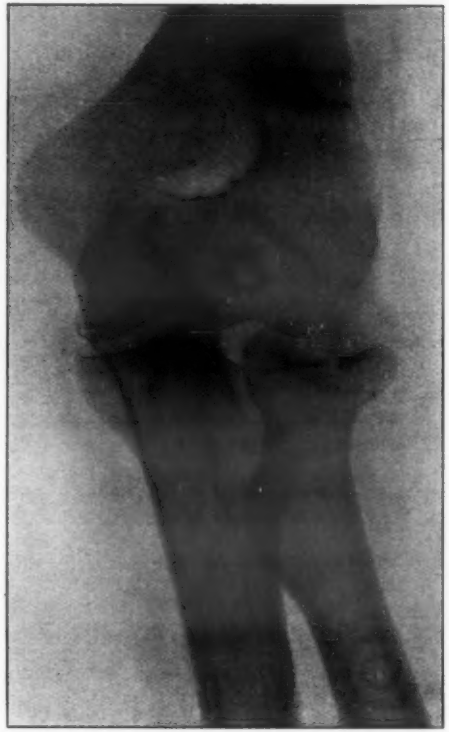


FIG. 2.

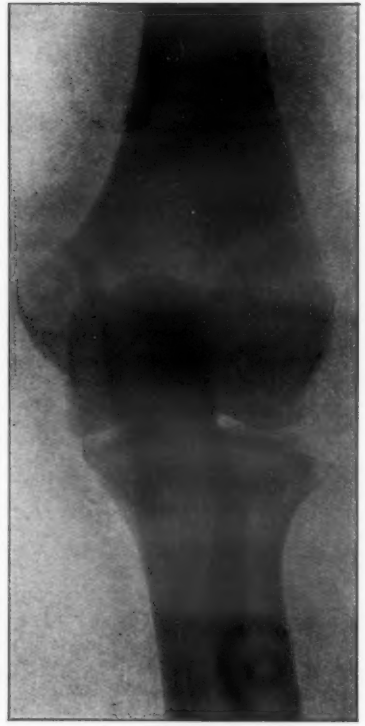


FIG. 3.

The fourth (fig. 4) shows an appearance which is quite common, in which the posterior and central part of the head is depressed. I thought at one time that the difference between this picture and the previous ones might be explained by the two different causes of the injury—this group being the result of a fall on the outstretched hand. In fact, it is not possible to tell from the picture which injury has occurred; this one results from a fall on the elbow, and the first slide from a fall on the hand.

The fifth picture (fig. 5) shows a further stage—where the fragment is completely detached.

FIG. 4.

Treatment.—The elbow seems to react to injury more severely than do other joints. It is a common observation that cases of supracondylar fractures and others about the elbow-joint, even though adequately reduced, are followed by a very slow return of full movement; full extension is often delayed for more than six months, and this too in children, in whom simple fixation of a joint in plaster produces hardly any delay in the return of a full range. Fractures of the head of the radius, even of the simplest type (an example of which is shown in fig. 1) show the same delayed return of function; they are furthermore very prone to develop traumatic osteo-arthritis to an extent and with a rapidity which has no parallel in any other joint. This severe reaction to injury of the elbow must be ascribed, I think, to some

peculiarity of the joint itself. It is not to be found in the size of the crack itself, because a similar crack in the ankle-joint allows a full range of movement from an early stage. In a supracondylar fracture of the humerus it might be ascribed to extra-articular adhesions following the considerable damage which occurs to the soft tissues, but this explanation will not explain the class of case to which I am now referring, as there is practically no extra-articular disturbance in a simple fracture of the head of the radius. I do not know of any explanation why the elbow-joint behaves in this way. It has one anatomical distinction—namely that in proportion to the area of articular cartilage there is less synovial membrane than in any other joint. It is conceivable that as compared with, for instance, the

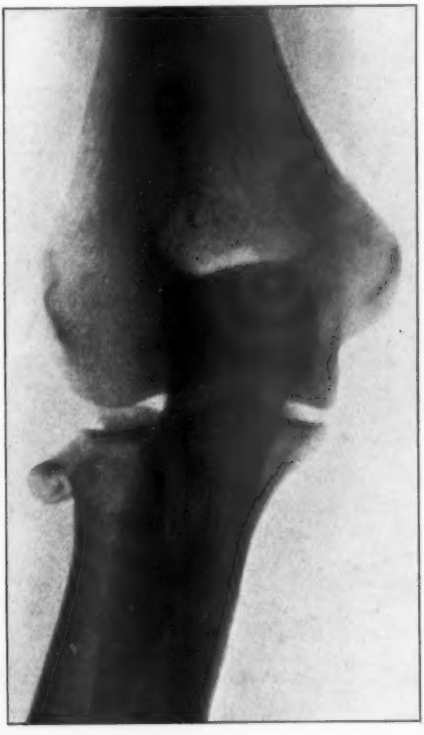


FIG. 5.

knee, the elbow is handicapped in the normal defensive measures of joints to injury, that is, an outpouring of synovial fluid adequate to protect the articular cartilage and to prevent the formation of adhesions, but this is only speculation and I have no facts to offer in its support.

From the practical point of view it is certain that what the elbow requires after injury is rest. Simple cracks of the head of the radius are satisfactorily treated by fixation in flexion by plaster, or collar-and-cuff, for three weeks, followed by active movements and no massage. A collar-and-cuff is less cumbersome, but requires readjusting to maintain the position of the arm. Full

movement returns from three to eight weeks after removal of the fixation. Treated in this way, of twelve cases of fracture without gross displacement, six have no pain at all now, five have an ache in wet weather, and one has more or less constant pain. All have a full range of movement. To the painful one I will return in a few moments.

If the fragment is grossly displaced, as in fig. 5, it should be excised. This was done in three cases which now have no pain, and limitation only of full supination. One after five years is still working as a porter.

The greatest difficulty arises in the borderline cases, in judging whether the fragment is sufficiently detached to warrant excision. This slide [not reproduced] shows considerable displacement of the fragment. The fracture was treated in the first place conservatively; I am inclined to think that I personally would have advised excision. After five months there was full flexion and extension at the elbow, but no pronation and no pain; the radiogram [not reproduced] shows that the fragment has united and forms a spur, which is probably interfering with the orbicular ligament. An operation was performed and the orbicular ligament divided; there is now, three years later, a full range of movement and an ache in wet weather, but no pain. My view is that if there is any doubt about the question it is better to excise the fragment.

In three cases of the series there is considerable pain. In the first the fracture was a simple crack; it was treated by movements (active and passive) and massage. At the end of three weeks the man had a full range of painless movement and returned to work as a painter. Eight weeks later the joint was painful and swollen; there was limitation of movement in all directions, and in the skiagram there can be seen an osteophyte. This is the direct result of inadequate rest. The second case is that shown in fig. 2. As the fracture was a complete one, the elbow was rested for four weeks in plaster. The patient has now an almost constant ache, and at the end of a hard day the joint is swollen and hot. Looking back on the case, I think she would have been better now had the fragment been excised, but even with this case in mind I should hesitate to advise immediate excision in a similar case again. The third case with pain is not illustrated. The first shows to my mind that whereas early movement and massage may hasten the return of movement, this mode of treatment is liable to be followed by arthritis. The other two show one of the difficulties in treating fractures, namely the different reaction of the same fracture to identical treatment in different cases. Deformation of joint surface alone is not an adequate explanation, as evidenced by the painless joint of the case in which the orbicular ligament was divided. How to get over this difficulty I am not quite sure. I think it might be advisable to excise a portion of the head of the radius, even though not grossly displaced, if, after three months, pain is still marked. I have, however, no experience of this method of treatment, and should be glad to hear of any case so treated.

Section of Surgery.

SUB-SECTION OF PROCTOLOGY.

President—Mr. W. S. PERRIN, M.Ch.

[*January* 13, 1932.]

Two Specimens of Carcinoma of the Cæcum removed by a Modification of the Classical Method of Ileo-cæcal Resection.—W. B. GABRIEL, M.S.

In operating upon the two patients from whom these tumours were removed, I decided to carry out a one-stage resection in view of the advanced stage of the disease locally. On account of the very poor general condition of the patients, I planned the following manœuvre which had for its object a shortening of the

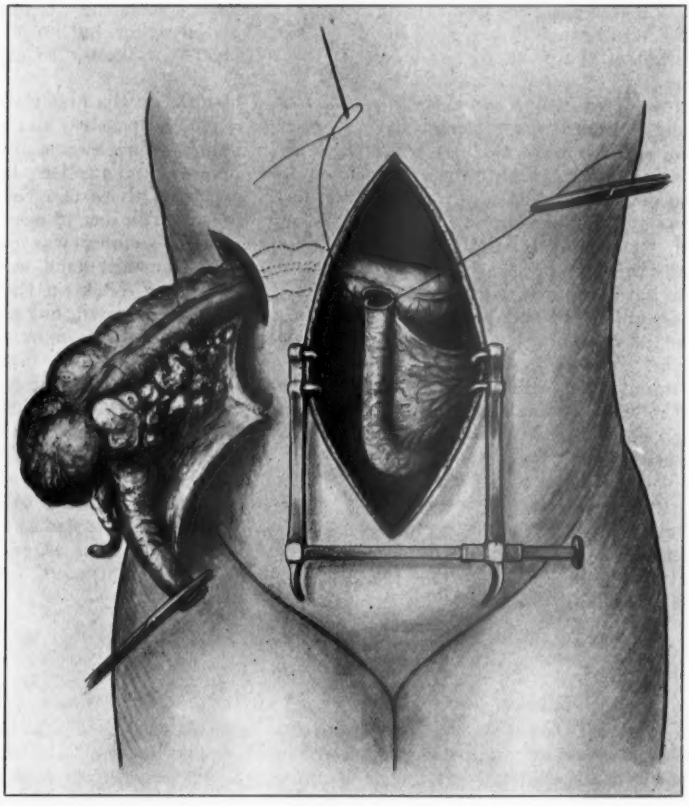


FIG. 1.—The ileo-cæcal angle has been mobilized and withdrawn through a separate incision in the right loin, the forceps holding the cut ileum being passed through the handle first. An end to side anastomosis between the ileum and transverse colon is being done. A large moist pack soaked in flavine, 1 in 1,000, is placed in the right loin at this stage to arrest any oozing from the cæcal bed. (Note: All details of clamps, towels and packing are omitted in the drawing for the sake of clearness.)

intra-abdominal part of the operation. By this method a desirable safety factor is introduced by exteriorization of the large bowel for section and, if thought desirable, drainage of the transverse colon in the region of its anastomosis with the small intestine can be provided.

Method.—The operation is performed through a long paramedian incision and its stage may be summarized as follows :—

(1) Ligation of the ileo-colic vessels high up, near the mesenteric trunk.

(2) Division of the small intestine between clamps about 6 to 12 in. from the cæcum.

(3) Mobilization of the cæcum, ascending colon and hepatic flexure of the colon.

Then instead of dividing and occluding the transverse colon according to the classical operation, the following manœuvre was carried out.

(4) An oblique incision 4 to 5 in. long was made downwards and inwards in the right upper abdomen, sufficiently large to admit the handle of the forceps crushing the ileum and the tumour for which the resection was being undertaken (fig. 1) ; the specimen was thus

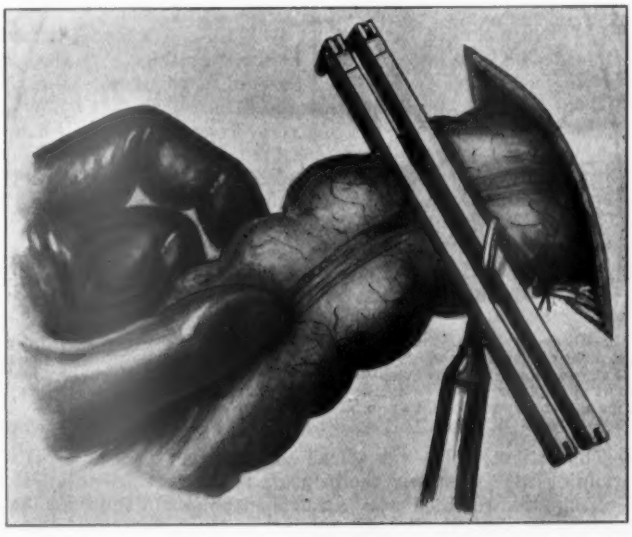


FIG. 2.—The colon is being divided by a Paquelin's cautery outside the abdominal wall, after removal of the central section of the de Martel's clamp.

delivered outside the abdomen and was left supported by the table on the right side of the patient.

(5) The anastomosis of the ileum to the transverse colon was next effected, in one case by end to side, and in the other case by side to side anastomosis (fig. 1). Great omentum was stitched carefully round the anastomosis.

(6) The peritoneum on the posterior abdominal wall was repaired, the terminal part of the ileum was arranged suitably, and the main incision closed without drainage. It was covered with gauze and a sterile towel.

(7) The oblique incision was partially closed by a few sutures until it fitted snugly round the emerging bowel. A triple de Martel's clamp was then applied to the bowel about 1½ in. from the abdominal wall and it was divided with a cautery in between the outer clamps (fig. 2).

(8) The colon was partially closed from each side, leaving a small opening in the centre to permit a catheter to be passed in to the level of the anastomosis (fig. 3).

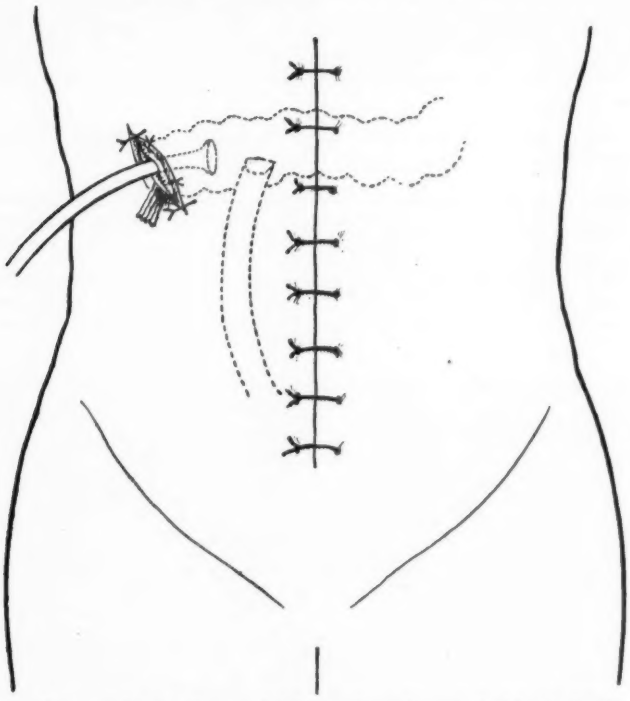


FIG. 3.—Diagram showing the completed operation: the main incision is closed without drainage. The de Pezzer catheter lies in the transverse colon, the expanded end reaching nearly to the anastomosis. The closed end of the colon is fixed to the skin by a few sutures and a short piece of corrugated rubber drain is inserted just below the bowel. The relation of the tube and anastomosis is shown in faint lines.

Case I.—The patient, S. D., was a frail woman aged 52. She was very anæmic and was running an irregular temperature; her resting pulse-rate was 112. Abdominal examination revealed a large movable tumour in the right iliac fossa.

The operation was performed April 2, 1931, and an uneventful recovery followed. The tube (a de Pezzer catheter with the end cut off) allowed flatus and a little fluid fæcal material to escape; the abdomen remained soft and flat. The tube was removed by gentle traction on the tenth day after operation, leaving a small circle of mucous membrane presenting. Later the colostomy was closed extraperitoneally under local anæsthesia. The patient remains in good health and now has an excellent colour. She has put on a stone in weight and her bowels are open regularly with small doses of aperients.

Specimen I.—Dr. Cuthbert Dukes reports as follows: "The specimen consists of the distal 4 in. of the small intestine, the ileo-cæcal valve, cæcum and a small portion of the ascending colon. A fungating tumour is situated in the region of the ileo-cæcal valve and completely encircles the lower portion of the cæcum. The lymphatic glands in the neigbouring portion of the mesentery were easily palpable.

Microscopic structure.—The tumour is an adeno-carcinoma which shows a good deal of colloid degeneration in some regions. The cells are fairly well differentiated and belong to Malignancy Grade No. 2. The growth has spread by direct continuity through the wall of the cæcum. The regional lymph nodes are very much enlarged as the result of an inflammatory reaction, but do not contain any metastases."

Case II.—The patient, E. W., was a frail and anæmic man aged 70: he was a diabetic. He gave a history of increasing anæmia and recent diarrhœa, with the passage of pink stools. There was a palpable mass in the cæcal region. The operation was performed October 1, 1931. His immediate progress was satisfactory, but later he was much troubled by passage of loose stools from the colostomy opening; this was possibly accounted for by intestinal indigestion, the result of pancreatic deficiency. He was put on to a pancreatic extract, but succumbed to an acute broncho-pneumonia twenty days after operation.

Specimen II.—"The specimen consists of the last 10 in. of the small intestine, the cæcum, appendix and a portion of the ascending colon. The anterior wall of the cæcum and part of the anterior wall of the small intestine has been removed to show a large fungating tumour completely encircling the cæcum at the ileo-cæcal valve.

Microscopic structure.—The tumour is an adeno-carcinoma which has infiltrated the submucous coat of the cæcum and commenced to invade the circular muscle. There is no sign of extra-colic spread. The mesenteric lymph nodes are much enlarged as the result of an inflammatory reaction but they do not contain metastases."

Ischio-rectal Abscess.—Sir CHARLES GORDON-WATSON, K.B.E., F.R.C.S.

An undergraduate, aged 21, after three days of rectal pain and rise of temperature developed signs of an acute ischio-rectal abscess. With the patient under an anæsthetic, I found that on pressure over the ischio-rectal fossa I could squeeze pus through a minute opening in one of Morgagni's crypts.

I laid open the abscess and the track which passed through the fibres of the external sphincter into the anal canal, and removed a portion of the track for section.

Microscopical examination of a section shows that the track is lined with transitional epithelium. This section resembles those shown by Dr. Dukes of peri-anal intramuscular glands during the discussion on fistula two years ago,[1] and I think it establishes the origin of this particular abscess in one of these glands. It demonstrates that these glands open into the anal canal, and thus explains the cause of many direct lateral fistulæ which seem to arise without history of previous abscess. In such cases, in all probability, an infection of the gland finds easy drainage into the anal canal so that an objective abscess in the ischio-rectal fossa never appears and the infection becomes chronic, ending in fistula.

Carcinoma (Grade 4) of the Rectum.—C. NAUNTON MORGAN, F.R.C.S.

G. W., aged 62, taxi driver, admitted to the Metropolitan Hospital, July 17, 1931, complaining of diarrhœa.

History.—For the last three months has been suffering from increasing constipation with passage of slime. No bleeding whatsoever; no pain. Has lost a good deal of weight. During the last month almost continual diarrhœa.

Condition on admission.—The patient looks ill. Mucous membranes pale.

Examination per rectum.—There is a long tubular stricture, just admitting the examining finger, extending down to the anal margin, its upper extent being out of reach. The mucosa is everywhere smooth but slightly nodular, indurated and œdematous. No bleeding, but a good deal of slime. There was marked pain on examination. The rectum appeared to be a rigid tube fixed anteriorly to the prostate but only slightly fixed behind to the sacrum. A small proctoscope was inserted with difficulty: there was no ulceration seen, the mucous membrane being smooth, deep red in colour, and extremely tough: it bled slightly during examination.

Operation, 20.7.31.—Exploratory laparotomy. Left rectus incision. The growth could be felt from the pelvis extending upwards to just below the peritoneal reflection, totally surrounding the bowel and slightly fixed in all directions. It was estimated to be about 3 in. in length involving the lower two-thirds of the rectum. A

1 *Proceedings*, 1929, xxii, 1331, *et seq.*

few small, soft glands were felt in the lowest part of the meso-sigmoid. The liver was free and no other glands were felt. A colostomy was performed through the exploratory incision. A piece of growth was removed from the rectum for biopsy. (?) Sarcoma. 12.8.31.—Perineal excision of the rectum was performed. The growth stripped easily from the prostate but there was marked œdema of the line of cleavage in front and of the post-rectal fat. A few small, soft glands were removed with the rectum. The patient made an uninterrupted recovery, the tissues healing well, allowing the patient to be out of bed on the twenty-first day.

Description of specimen.—The specimen measured 9 in. in length, there being a flat, only slightly ulcerated growth, 2 in. in its long axis, completely encircling the lower third of the rectum. The growth caused a great deal of thickening of the rectal wall and peri-rectal tissues. The lower edge extended down to the ano-rectal line and there were 2½ in. of normal bowel above. The surrounding mucous membrane was very rough and nodular.

Microscopic structure.—The tumour was composed of closely packed polygonal cells forming a solid mass of growth which was infiltrating the muscle wall of the rectum and had spread by direct continuity into the peri-rectal tissues. The histology of the tumour was that of an adeno-carcinoma, Grade 4. The regional lymph nodes contained metastases. From the point of view of prognosis this was a "C" case.

Deep X-ray treatment.—Ten doses of hard X-rays to the perineum and lower abdomen.

Present condition.—The patient is very well and is about to restart his work as a taxi driver.

Commentary.—There is very little reference to this diffuse submucous carcinoma of the rectum in any of the standard works on pathology or rectal surgery. There is a description and photograph in Gant's "Diseases of the Rectum" of a somewhat similar case. The macroscopic description is almost identical with that of the specimen I have shown, but the microscopic appearances are said to be those of a slowly-growing carcinoma, the malignant cells being strangled by dense fibrous tissue. On the other hand, the histology of this specimen proves to be, without doubt, a very malignant tumour, the cells of which are very dedifferentiated. The sections are identical with several of Broder's Grade 4 specimens of which I have had the opportunity of studying. The clinical differential diagnosis of this type of carcinoma from sarcoma of the rectum must be extremely difficult, and biopsy in this case only settled the diagnosis, after very careful examination of the section. There are some regions in the sections, especially in the submucous coat and in the glandular metastases, in which there is a suggestion of a glandular arrangement. This type of carcinoma of the rectum might well be described as a "leather-bottle" rectum, since it is very similar to the diffuse submucous carcinoma of the stomach.

Endothelioma of the Rectum.—C. NAUNTON MORGAN, F.R.C.S.

Mrs. E. E., aged 72. Admitted into the Metropolitan Hospital 17.9.31.

History.—Eighteen months: Pain and prolapse on defæcation. One month ago: Severe rectal hæmorrhage with passage of large quantities of foul-smelling slime; no diarrhœa; bowels open with medicine. No loss of weight.

Condition on admission.—The patient was an extremely frail old lady and had severe urinary infection with marked cystitis.

Examination per rectum.—There was a pedunculated polyp an inch and a half in diameter, arising from the posterior rectal wall one inch and a half from the anus. It was smooth and hard, the surface being slightly ulcerated at one place. The base of the pedicle was soft and non-indurated. It could be brought to the anal orifice with ease.

Operation, 18.9.31.—Examination was carried out under gas and oxygen anæsthesia. The base of the polyp was clamped and ligatured and the tumour excised. There were several hard submucous tumours felt in the posterior rectal

wall, higher up, the mucous membrane was everywhere freely mobile over them. Further investigation of these tumours was thought unjustifiable owing to the patient's general condition. 8 mc. of radon in four seeds were inserted into the base of the polyp and also into the submucous tumours.

Present condition.—There is nothing abnormal felt in the rectum. Sigmoidoscopy also revealed nothing to 12 cm. The patient has been free from bowel symptoms since the operation.

Description of specimen.—The specimen consisted of a round tumour one inch and a half in diameter, its cut surface being smooth and greyish white in colour. Its surface was slightly ulcerated.

Report on microscopical examination.—The tumour is composed of closely packed large polygonal cells which are infiltrating the muscle coat of the rectum. Many of the columns of cells are arranged around primitive capillaries, containing red blood-cells, and the general arrangement and histology of the tumour is that of an endothelioma arising from vascular endothelium.

Commentary.—The only references to endotheliomata which I could find in the standard works were in Ewing's "Neoplastic Diseases," and Yeoman's "Diseases of the Rectum." Ewing says, "The existence of true endotheliomata of the gastro-intestinal tract remains unproved, if not improbable." The existence of a case of endothelioma of the cervix uteri was denied, and Hansemann's theory that the so-called scirrhus carcinoma of the stomach was an endothelioma developed from the submucous lymph spaces was thought extremely unlikely. Brief reference was made to endotheliomata in Yeoman's work. He says that they were rare tumours similar to gliomata which had been reported in the sacro-coccygeal region. There is no mention, however, of endotheliomata arising *in* the rectum.

Lockhart Mummery and Gabriel reported a case of sarcoma of the rectum which, on further investigation, was described by Professor Shattock as a benign endothelioma.[1] The specimen is at present in the Museum of the Royal College of Surgeons. The rectum was removed by perineal excision, and presented a hard, nodular, submucous growth, involving the anterior wall of the rectum two inches from the anus. The tumour was a white, fasciculated submucous growth with mucous membrane apparently intact over it, and there was no sign of invasion of the muscular wall.

Specimen of Recurrent Procidentia with Diverticulosis. ERNEST MILES, F.R.C.S.

The specimen was removed from a woman, aged 67, who had suffered from prolapse of the whole rectum for five or six years.

There was no sign of inflammation in the diverticula, and the specimen was of interest since inflammation was thought by some authors to be the cause of diverticulosis.

Specimen of Secondary Sarcoma of the Pelvic Colon removed by Abdomino-perineal Excision.—ERNEST MILES, F.R.C.S.

The patient had suffered from a round-celled sarcoma of the uterus which was adherent to the colon. About six months after hysterectomy she was seen on account of difficulty of defæcation. Death occurred from deposits in the lung six months after the removal of the growth in the colon.

Specimen of Endothelioma of Rectum.—LIONEL E. C. NORBURY, F.R.C.S.

The patient, a woman aged 30, gave a history of spurious diarrhœa, with passage of mucus and occasional blood for several months.

Sigmoidoscopy.—Growth seen at 15 cm.; portion removed for microscopical examination.

Report (Dr. Cuthbert Dukes).—"Histological appearances are those of an endothelioma, arising from vascular capillaries."

[1] *Proceedings*, 1919, xiii, Sect. Surg. (Sub-Sect. Proct.), 14; 1921, xiv, Sect. Surg. (Sub-Sect. Proct), 80.

October 31, 1931.—Abdominal exploration revealed a mass of soft matted glands in the mesentery in the region of the hepatic flexure; a similar but smaller mass was present in the mesentery of the small intestine. Liver normal. No glands palpable in pelvic meso-colon. No evidence of growth or ulceration in large bowel other than that in the rectum. Left iliac colostomy performed.

"It was a question as to whether the enlarged glands mentioned were due to old tuberculous disease or were secondary to the rectal growth."

November 22, 1931.—Perineal excision of the rectum. The patient made a good recovery.

Report on excised rectum (Dr. Dukes).—"The specimen measured 6½ in. and consisted of rectum, anal canal and peri-anal skin. The middle third of the rectum was semi-ulcerated, nodular on the surface and with greatly thickened walls leading to stenosis of the lumen. The nodular thickened area extended completely round the rectum and was 2½ in. in its long axis, and there was half an inch free margin above. Sections were cut for microscopic examination from the edge of the growth, and peri-rectal tissues behind the ulcerated area and from the lymphatic glands accompanying the superior hæmorrhoidal vessels.

Microscopic structures.—The mucous membrane of the rectum is partially ulcerated and the submucosa and muscle infiltrated with a tumour composed of spherical or polygonal cells with large nuclei, many of them arranged in groups round primitive vessels. The tumour has the general histology of an endothelioma arising from vascular endothelium. The growth has spread as far as the peri-rectal tissues but the regional lymphatic glands do not contain any metastases."

I have no knowledge of any similar case except that shown to-day by Mr. Naunton Morgan. The condition must be very rare indeed. I can find no record of such a case in the literature.

Extensive Prolapse of Rectum: Second Degree. — LIONEL E. C. NORBURY, F.R.C.S.

J. J., male, aged 28.

For six or seven years a prolapse as large as a fist had occurred every time the bowels were open. There was incontinence of fæces and the sphincter muscles were very weak.

Operation, September, 1931.—Peri-rectal injections of quinine and sulphuric acid (2 drachms of the following solution): Quin. sulph., gr. xii; ac. sulph., dil. m. xxx; water, m. xxx. This was injected into the peri-rectal tissues (through a needle 3 in. long by three punctures—two lateral and one posterior—entering the skin about one inch from the anus), combined with linear cauterization of the mucous membrane, and followed a few weeks later by a course of submucous injections of phenol, 5% in almond oil. There has been no prolapse since discharge from hospital, and there is no incontinence.

Tumour of Recto-Vaginal Septum.—LIONEL E. C. NORBURY, F.R.C.S.

A. B., female, aged 70. History of long-standing pain in rectum and lower abdomen and of increasing constipation.

On examination.—Large, rounded, smooth swelling present in recto-vaginal septum; slight ulceration of rectal mucous membrane. Tumour apparently not attached to cervix uteri.

Diagnosis.—(?) Endometrioma; (?) cyst.

Operation.—Friable tumour, infiltrating both vaginal and rectal walls, removed piecemeal; communication between rectum and vagina resulted; subsequent colostomy.

Microscopical report on tumour.—Fibro-sarcoma.

General condition of patient.—Excellent at the present time. Treatment of tumour with radium is under consideration.

Section of Dermatology.

President—A. M. H. GRAY, C.B.E., M.D.

[*February* 18, 1932.]

Demonstration of South African Tuberculoid Leprosy.

By H. W. WADE, M.D.

(*Medical Director, Leonard Wood Memorial for the Eradication of Leprosy, New York.*)

IT is my privilege to demonstrate, more or less briefly and informally, an unusual type of tuberculoid lesion of leprosy recently observed in South Africa. This is not so much for the purpose of recording the observation as in the hope of eliciting discussion concerning allied changes in other diseases, which may throw light on the nature and pathogenesis of this condition in leprosy.

Heretofore tuberculoid leprosy lesions, when recognized at all, have usually been looked upon as rarities and not as an important part of the picture of leprosy. It was because of this that the subject was not even proposed for the agenda of the Leonard Wood Memorial Conference on Leprosy, held in Manila a year ago, which adopted a new basic classification of cases of leprosy. Observations made during the past year in Japan, India, and, especially, South Africa, have convinced me that these tuberculoid changes should receive more attention than hitherto.

In neural leprosy there occur a number of changes that are to be distinguished from the true lepromata, which are the familiar bacillus-containing lesions of ordinary "cutaneous" (the old "nodular") leprosy. European leprologists have long since distinguished certain conditions of this sort, which they term "leprides." This is a general term which seems useful and entirely appropriate if properly defined.

As I now understand it, the distinction between lepromata and leprides, at least so far as skin lesions are concerned, is much the same as that between skin tuberculosis and the tuberculides. In both cases the first-mentioned lesions are obviously due to the presence in the skin of the ordinarily active bacilli. The nature of the latter processes is more obscure, but evidence indicates that the infecting organisms, in whatever manner or form, are directly responsible. In leprosy, unlike tuberculosis, there is the necessity of distinguishing from this group such skin changes as are not caused by active processes therein, but are merely secondary to disturbances of the nerves. Whether this can always be done with certainty on the basis of present knowledge is perhaps doubtful.

As is true of the tuberculides, there are leprides of diverse characteristics. Disregarding for the present all other features, they can be divided according to the histological changes into two classes: (1) those which are of simple, chronic inflammatory nature, and (2) those which are tuberculoid. Lesions of both histological types may resemble each other more or less closely.

An important group of leprides consists of the familiar lesions commonly termed "macular" or "maculo-anæsthetic." Some leprologists set cases with manifestations of this kind apart from the "nodular" on the one hand, and the simple

" nervous " on the other, though it seems clear that they are really a sub-class of the neural type. The major characteristics of these lesions, wherever seen, are so similar that it seems not to be generally appreciated that they may differ radically in their pathology. In Japan and India sections from such cases shown to me were frankly tuberculoid. In Norway, on the other hand, the slides showed only simple chronic inflammation; according to Lie, of Bergen, only one case of tuberculoid leprosy has been reported from Norway (Bruusgaard).

Up to the present no criteria have been established that will permit of definite distinction between the two types of this lesion, by means available to the clinician alone. This must involve no more elaborate microscopic work than the examination

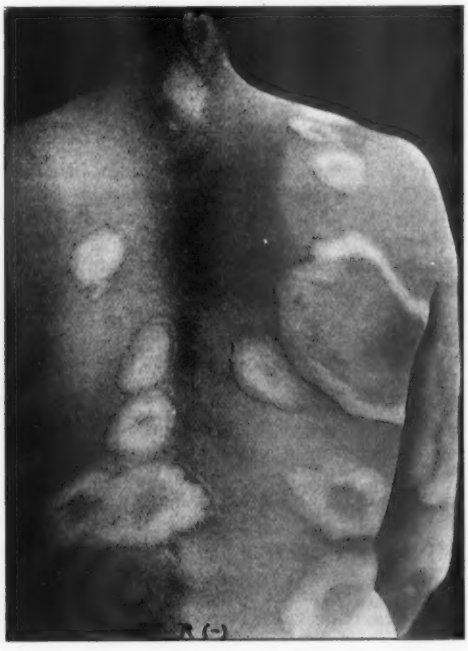


FIG. 1.—Patient with numerous and fairly extensive lesions, some confluent, showing rather marked elevation of the outer, active margins, a broad infiltrated zone and apparently complete central healing.

of bacteriological smears—without which, it may be remarked, leprosy work cannot be done properly. I think, however, it will be agreed that such distinction can be made between the simple macular leprides as illustrated by photographs given to me by Lie, and at least the typical tuberculoid ones as seen in South Africa.

The two types of progressive macular leprides have certain basic characteristics in common. (1) They tend to be more or less superficial, involving chiefly the upper layers of the cutis; (2) they spread from centres of origin and often involve extensive areas of irregular contour; (3) they tend to heal centrally, often with little or no evidence of fibrosis, rarely if ever with the scarring of similar tuberculous and syphilitic processes, and (4) the active margin appears to be the locus of an active process. But ordinarily the degree of infiltration in the margins of the simple

macular leprides is comparatively slight, and the surfaces are fairly smooth and regular. Even in the simple (non-tuberculoid) lesions there would seem to be considerable variation in features, such as width of the unhealed zone and in pigmentation (as illustrated by comparing photographs of Norwegian and Russian cases), but these are apparently secondary features.

Very different are at least the more typical of the tuberculoid lesions seen in South Africa, though at a casual glance some of them might seem to be the same except for such difference as would be expected in coloured patients, namely, more or less hypopigmentation of the active zone, in which erythema, when perceptible to the eye, in not evident in photographs. But closer examination reveals two

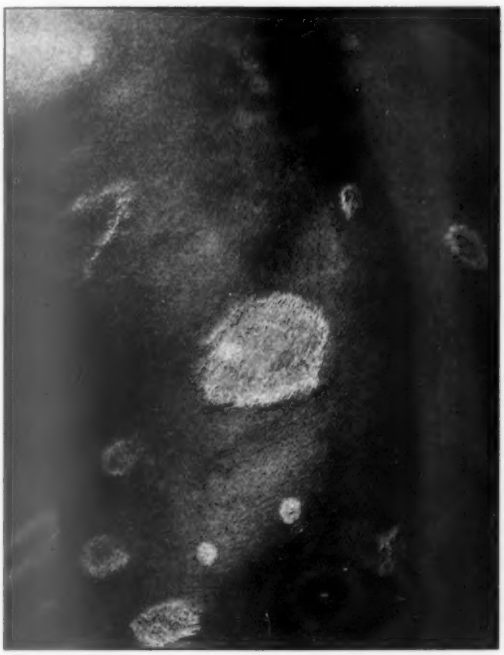


FIG. 2.—Closer view of typical earlier lesions, showing clearly the pebbled ("micro-papular") surface of the active zones, and the tendency to central healing as the lesion enlarges.

striking features. These are: (1) The degree of infiltration, which often raises the lesions abruptly and conspicuously above the level of the surrounding skin, and (2) the rough, pebbled surface (figs. 1 and 2). This rough, "granular" appearance—Professor Jadassohn designated it "micro-papuleuse"—is due clearly to the greater tendency to marked focalization of the tuberculoid change than is seen in the infiltration of the simple macule.

There are great variations in size of the different lesions, and marked irregularities of contour, especially, of course, where adjacent lesions have fused. Nevertheless, at least for a time, there is a tendency to spread more or less uniformly in all directions, except where lesions are near certain areas which seem to be immume to the invasion. These are especially the axilla and the groin. On the shoulders,

where there is a decided tendency to bilateral distribution, the tendency to extend forward seems much less than to spread over the scapular area.

Marked differences are seen in the process of central healing. Often it is quite prompt, so that the infiltrated zone is narrow; sometimes it is hardly more than a rounded, cord-like band. More usually, however, recovery is neither prompt nor regular, so that wide, irregular, granular zones exist. Often, indeed, one sees broad plaques with little or no tendency to return to normal.

Recovery is often surprisingly complete. Sometimes one can detect no distinct difference from the unaffected skin outside, either in appearance or in consistence. Usually, however, there is some difference in texture, and the fingers detect some fibrosis. It is not to be understood that when there is central healing this is always complete, for foci of disturbance may be seen in these centres. Whether they are residual or due to recurrence it is sometimes difficult to say.

Among large groups of these cases one sees many variations of the lesion, such as interruption of the advancing zone, and progress that apparently disregards peculiarities of structure, but these need only be remarked here.

A striking phenomenon sometimes seen in these cases is local (lepra) reaction in the active areas. This is characterized by increased erythema and infiltrations. According to my information this is sometimes, if not usually, of long duration—up to a year or eighteen months. Apparently it is only in this condition that erosion and scaling of these lesions is seen.

Of special interest is the fact that the sensitivity to light touch is typically not diminished in the affected areas, which is quite different from the case with the classical maculo-anæsthetic leprides. Judging from a few tests the discrimination between hot and cold is apparently disturbed. As for the pain sense, or the perspiration of the involved skin, these are among the points which, it is hoped, will be studied by the clinicians in South Africa.

Bacteriological smears from the ordinary typical lesions are negative. The same is, of course, true of the maculo-anæsthetic lesion, though, according to the European authorities, a few bacilli can usually be found on histological examination by careful, persistent examination of many sections. The present material has not yet been examined in this manner. A number of tuberculoid lesions were so studied at the Culion colony some years ago with negative results.

In prolonged reaction, however, bacilli evidently tend to multiply. Though smears from one or two patients in this condition were negative, bacilli were found in those from three others in whom the reaction was especially marked and of long duration. They were scarce, and had to be sought through many fields, which is entirely unlike the case in ordinary cutaneous leprosy, that is, in the true lepromata. Sections of the biopsy material taken from two of these cases show that the lesions had not been transformed from the tuberculoid type, but rather that this had become intensified and exaggerated.

Biopsy specimens were taken from a total of sixteen cases which were thought to be tuberculoid, and sections of all of them show such change. The histological pictures as a whole vary considerably, but in each there is the essential character of foci of epithelioid cells. These foci vary in extent from tiny groups of a few cells to large, sarcoid-like areas. Giant-cells are to be found in most sections, though typically they are few, and several sections do not contain them. They are especially abundant and conspicuous in the reaction lesions. Round-cell infiltration, too, may be slight, but usually is fairly abundant and in some instances extensive.

The pathological condition as a whole is focal, discontinuous in the lesser lesions, but in the more marked forming broad bands in the upper papillary layer of the dermis. In the deeper layer the change, when present, is focal and less extensive; the foci are in relation with the auxiliary structures—hair, sweat-glands and nerves—where the vascular supply is richest.

Concerning the nature and pathogenesis of the tuberculoid change in leprosy there is room for discussion. As to its nature, there are few who are still inclined to ascribe it to tuberculosis, and at most these hold that this possibility has not been eliminated. Granting that in the earlier days of leprosy study changes that were actually tuberculous were sometimes ascribed to leprosy, the tendency is now perhaps in the other direction. Nevertheless, since tuberculoid skin lesions of leprosy were first described as such by Jadassohn in 1898, most leprologists are, I think, agreed that such lesions are a manifestation of that disease and not a complication. The evidence is clinical rather than experimental, since ordinary laboratory tests are negative with both tuberculides and leprides. Neurological considerations are sometimes decisive. The tuberculoid macular leprides are clinically different from any known tuberculide; at least, dermatologists whom I have consulted agree that is true of this South African material. The frequency with which these occur there—I was informed that it is seen in 15% to 20% of the patients in certain of the institutions—and its apparent non-occurrence in other conditions is not to be ignored. In that country the changes here demonstrated are recognized by natives and physicians alike to be manifestations of leprosy.

As for the mechanism of causation of the tuberculoid leprides, which in its constitution differs so radically from the ordinary leproma, we have a few facts and a wide field for speculation. The facts are that the changes occur usually, if not exclusively, in cases of the "neural" type, and that the outstanding characteristic of that type of the disease is an obviously high resistance to the bacillus. It may be ventured that the factor which determines that a case shall be "neural" and not "cutaneous" does not alone determine the production of the tuberculoid lesion; otherwise it would be expected that all leprides should be tuberculoid. One therefore must invoke a special condition, and fall back on the idea of some peculiar sensitization of the tissue—some special form of allergy.

As for what it is that stimulates this reaction in the affected areas, invades in wave-like fashion the adjacent skin, and tends to disappear as the wave passes, in would be hard to assume any other than a living organism which multiplies locally. This would, of course, be the leprosy bacillus, though whether in its ordinary or in some special form it is impossible to say. It has often been found, though usually with difficulty, in the simple (non-tuberculoid) leprides. The usual impossibility of finding it in the tuberculoid lesions, and the usually marked degree of the tissue changes would seem to bespeak either a great sensitivity and reaction to a very few bacilli, or the presence of some undetectable form of it. Could the pathogenesis of the tuberculides, in which similar conditions exist, be definitely explained, it might be possible to explain the tuberculoid leprides.

[To the authorities of the Union of South Africa and the Emjanyana Leprosy Institution I am indebted for permission to make this study and for aid in collecting material for it. Dr. R. A. Davison, Medical Officer at Emjanyana, assisted me materially and furnished much clinical information. For the sections obtained acknowledgment is due the Health Department laboratory at Cape Town. For information bearing on this subject I am indebted to various persons who have been consulted, especially to Dr. J. M. H. MacLeod and Dr. L. K. Muende here in London, Dr. H. P. Lie of Bergen, Professor Jadassohn of Breslau, Professor Klingmuller of Kiel, Dr. Unna of Hamburg, and Dr. Schaumann of Stockholm.]

Discussion.—Dr. H. P. LIE: The question of tuberculoid leprosy is interesting for all leprologists. In Norway we have searched for this form for many years, but only one single case has been found, and in this it was impossible to find any relation to other lepers. All new cases of leprosy during recent years have been in connection with other lepers. On the other hand, tuberculides and sarcoids are rather common in Norway without relation to lepers.

I have myself examined only a few cases of tuberculoid leprosy, and in most of these the patients were of coloured race. I am therefore inclined to believe that there may be a special

form of reaction against the invasion of leprosy bacilli, and we have perhaps to deal with a matter relating especially to races and climates if tuberculoid leprosy is caused by leprosy bacilli; I say if because I think it is difficult to exclude the presence of tubercle bacilli in such cases. Tubercle bacilli are very common among lepers; they may be there without any clinical symptoms of tuberculosis.

In the statistics of Norway we ordinarily have only two forms of leprosy—the nodular form and the maculo-anæsthetic form. We mostly designate the leprides as the beginning of the maculæ in the maculo-anæsthetic form. The leprides and maculæ may disappear completely in some cases. Leprosy bacilli are to be found in all leprides, but in scanty number, and in the maculæ also if one makes careful search at the right time and in the right place. The examinations must always be made in sections from pieces of skin taken by biopsy; smears are not sufficient. In Norway it is only those cases in which it is impossible to find any sign of leprides or maculæ that we designate as purely anæsthetic or purely neural cases.

Dr. J. M. H. MACLEOD said that the first time he had had the opportunity of seeing sections of the so-called tuberculoid leprosy described by Dr. Wade, was in 1926, when, through the kindness of Dr. Molesworth, he had seen sections of a case from Sydney. In the same year this case and three others were recorded by Tebbutt in the *Australasian Medical Journal*. On seeing the sections he had at first believed them to be tuberculous, and was in doubt of the diagnosis of leprosy, as their histology seemed indistinguishable from that of tuberculosis of the lupus vulgaris type. If further observations proved that these lesions were purely leprotic, and not due to a mixed infection, it was possible that they corresponded in some ways to certain tuberculides and were related to leprosy as the tuberculides were to tuberculosis. It was also possible that they might be due to attenuated or dead bacilli.

Sir LEONARD ROGERS said he had not had experience of this form of leprosy, but he would like to ask two questions: (1) How far were these cases infective? (2) How did they react to treatment?

Dr. S. E. DORE asked whether reaction to chaulmoogra could be regarded as representing the existence of active leprosy. A case of anæsthetic leprosy under his care and regarded as non-infective by Sir Leonard Rogers, developed a macular eruption as the result of injections of E.C.C.O.

Sir LEONARD ROGERS, in reply to Dr. Dore, said there were very few cases in which there were bacilli in the skin. The injections of chaulmoogra caused a reaction because the bacilli were probably broken up, but not destroyed. There were cases of leprosy of the skin without obvious active lesions, and the disease was carried to all parts of the body by the circulation, so that nodules might develop later. There were reactions from the local lesion, and that lesion might disappear, representing part of the process of cure of such lesions.

Dr. WADE, in reply, said that the remarks of Dr. Lie raised the old question of the relation of tuberculosis to these tuberculoid lesions. Dr. Lie and he were in agreement on many points concerning leprosy, and he felt that if Dr. Lie had worked in countries where the conditions described in the paper occurred, he would be convinced that the condition was not tuberculous. In the first place he, the speaker, had repeatedly seen it develop secondarily in treated cases, cases which had been bacteriologically positive, mixed cases. Treated for a long time, the bacteriologically positive lesions in these cases disappeared, but certain peculiar lesions persisted—when they appeared was not known. On bacteriological examination they were unexpectedly found to be negative, and microscopical examination showed them to be tuberculoid. No acid-fast bacilli were found and guinea-pigs inoculated with material from several cases showed no infection. Since a tuberculoid lesion of leprosy had first been described as such by Jadassohn, in 1898, those who had had the opportunity of studying cases had become convinced that these lesions were manifestations of leprosy. Motta, in Brazil, had recently reported a case in the study of which he had gone further than anybody else, even trying to bring out a latent form of the tubercle bacillus according to the technique of the Pasteur Institute—carrying on from one guinea-pig to another, in the hope of finding tubercle bacilli at the second or third attempt. In South Africa 15% to 20% of the cases in the institutions had this type of lesion, and they had also some of the other manifestations of leprosy of the neural type. Were this lesion actually a tuberculide, a tuberculous lesion developing in so large a proportion of cases of leprosy, one would surely

expect that it would occur in cases of other diseases. The fact was that in South Africa the natives and the physicians alike recognized it as a manifestation of leprosy.

Concerning the neurological disturbances in these lesions he could say little; the clinicians in South Africa would, it was hoped, publish such studies. He had spent only a few days in these institutions, collecting material for study from the pathological viewpoint. However, he could say that many lesions which he had tested were not hypo-æsthetic to light touch, though in ordinary macular leprides, as seen in Norway for example, there was anæsthesia. A few tests had shown definite disturbance of perception of heat and cold.

Concerning the infectiousness of these cases, the bacillus could not be found in smears from the ordinary lesions—only in those from the exceptional cases of prolonged lepra reaction. Therefore, on the basis of the generally accepted criterion of infectiousness, these cases were not infectious. In South Africa there were many "straight" nerve cases which had the ordinary types of macules. They improved on combined local and chaulmoogra injection treatment, and many of the tuberculoid cases cleared up and the patients were sent away.

That reaction to chaulmoogra was evidence of activity of the lesion he thought probable, though of course often such reaction did not occur during treatment. Reaction to iodide of potassium was a test which had been much used, often with unfortunate results. He regarded potassium iodide as dangerous in leprosy; in one part of South Africa that test had been employed as a routine to determine whether a case should be isolated or could be sent back home. When reddening of the margins of the lesions occurred the patient was sent to the institution. However, in his visits in South Africa and elsewhere he had seen several cases which were in a bad way as a result of the use of iodide of potassium. The clinicians at Culion had never undertaken to give potassium iodide to their patients.

Telangiectasia Macularis Eruptiva Perstans (Parkes Weber).—H. W. BARBER, M.B.

Mrs. C. G., aged 56.

This is a remarkable case, comparable to those recently exhibited and described by Dr. Parkes Weber (*Brit. Journ. Derm. and Syph.*, 1930, xlii, pp. 374-382: *International Clinics*, II, Series 41, 131) under the above title.

According to the patient's statement, the condition appeared first on the chest about a year ago. She is an obese woman. The eruption seems to confirm Dr. Parkes Weber's view that his "telangiectasia macularis eruptiva perstans" is allied to, or a variety of, urticaria pigmentosa of adults, for in my patient the lesions on the anterior and inner sides of the forearms and on the inner sides of the upper arms are, I think, characteristic of the adult form of urticaria pigmentosa: their bilateral symmetry is striking. On friction they become redder and slightly raised.

On the face there are "thread-like and arborescent telangiectases of the ordinary type" as in Dr. Parkes Weber's case. On the neck and temples are brown macules. On the chest, abdomen, thighs and in the popliteal spaces the eruption is identical with that of Dr. Parkes Weber's patient, as illustrated in his recent article. It consists of dull red macules of varying size, the red tinge being much more evident than in the lesions on the arms. The individual macules are, for the most part, roughly circular in shape, but there is a tendency to confluence, with the production of irregular patches. In Dr. Parkes Weber's patient the back was relatively free, but in my case the lower dorsal and lumbo-sacral regions in particular are involved. Dr. Parkes Weber emphasizes the point that "though the macules are clearly due to permanent telangiectatic hyperæmia, no individual dilated blood-vessels can be distinguished in them by careful naked-eye examination," or apparently by diascopic pressure. In my patient, however, it will be observed that individual telangiectatic vessels can be seen, notably on the breasts.

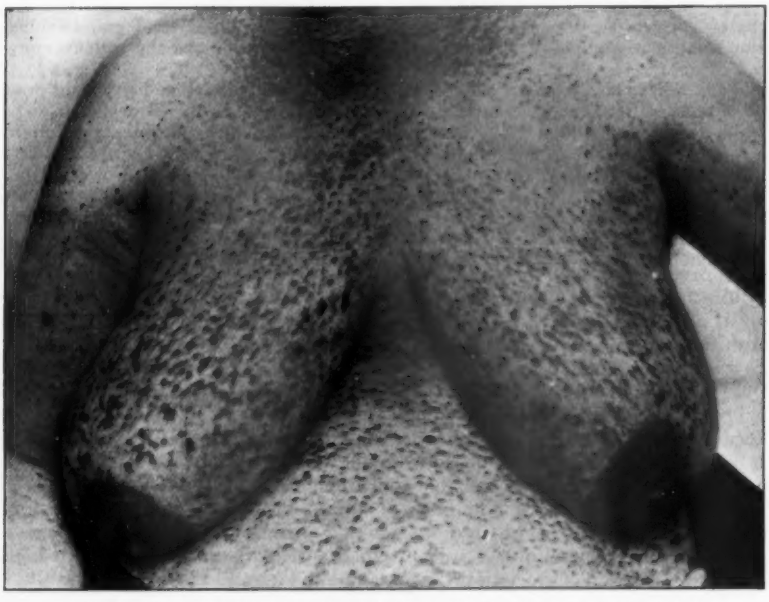
Investigations.—In view of the association of "spider-angeiomata" with hepatic disease, tests for hepatic insufficiency were kindly carried out for me by Dr. J. H. Ryffel and Dr. G. H. Oriel.

The Van den Bergh reaction, both direct and indirect, was negative.

The lævulose-tolerance test: Blood (1) fasting = 0·105%; (2) one hour after taking 50 gms. of lævulose = 0·125%; (3) two hours after = 0·111%.

Twenty-four hours specimen of urine: Specific gravity 1020; acid; no albumin; no sugar; urates present; no excess of urobilin or urobilinogen.

Fæcal residues normal. Stercobilin present. There is, therefore, no evidence of marked hepatic insufficiency. Biopsies were made from lesions on the skin over one breast and the abdomen. The dilatation of the vessels is well seen in the microscopical sections submitted. Around them is a fairly dense cellular infiltration, the cells being of various types. Dr. Forman has kindly stained some sections with a view to demonstrating mast-cells, which are present in considerable numbers. The epidermis is flattened, the papillæ and interpapillary processes being ill-defined.



Dr. Barber's case of telangiectasia macularis eruptiva perstans. (Parkes Weber.)

Discussion.—Dr. PARKES WEBER said that the case was almost exactly similar to the one that he had shown under the same descriptive heading at the meeting held on October 16, 1930, as probably a telangiectatic variety of urticaria pigmentosa. In the colour and appearance and distribution of the lesions and in the general build and obesity and ordinary facial telangiectases of the patients the two cases resembled one another closely, but in Dr. Barber's case individual telangiectases could be clearly distinguished by the naked eye in some of the red macular lesions over the trunk. Dr. Barber's microscopical examination of one of these lesions confirmed the relation of the condition to urticaria pigmentosa, as far as the presence of mast-cells counted.

Acanthosis Nigricans (Forme Fruste).—H. W. BARBER, M.B.

Mr. J. G. C., aged 52. Foreman in a gas company. Was first seen by me, at the request of Dr. Pike of Stevenage, in January, 1931, on account of irritation of the skin. His story was that two months previously he had a severe shock owing to an escape from a gas main, for which he was responsible. The irritation of his skin began some weeks later, and shortly after this he observed that numerous papillomata rapidly appeared on different parts of the skin. Apart from nervousness evoked by the shock and from the pruritus, he was in good health and had not lost weight.

On examination at that time there were: (1) Numerous discrete papillomata of various sizes, some sessile, others rather pedunculated, scattered over the trunk, on the neck, in the flexures, and in the umbilical folds. Many were scratched, with blood-crusts attached, perhaps indicating that their site corresponded to particularly irritating areas. (2) Diffuse papillomatosis along the axillary borders and to some extent on the neck with increased pigmentation, but he was unable to say whether the latter was of recent origin.

Members may remember a patient whom I showed before the British Association of Dermatology in 1930—a man with obvious acanthosis nigricans associated with a carcinoma ventriculi of the "leather-bottle" type. In his case the symptom which brought him to me was the rapid appearance of papillomata similar to those in this patient.

In view of this, my present patient was admitted to Guy's Hospital under Dr. Poulton, for investigation, but no evidence whatever of abdominal carcinoma was obtained. While in hospital the irritation diminished, and many of the papillomata disappeared spontaneously; the pigmentation also became less marked.

In January of this year, Dr. Pike asked me to see him again, and I did so on January 27. He stated that he had been entirely free from irritation for four or five months after his discharge from hospital, and that many of the papillomata had vanished. Then the pruritus returned and with it more papillomata than he had had previously. On examination these were found in large numbers around the neck and axillæ, on the front and sides of the chest, in the umbilicus and groins, and on the eyelids and forehead. There was also increased pigmentation with diffuse papillomatosis of the axillæ, neck, antecubital fossæ, and popliteal spaces. The pruritus was evidently severe. The blood-pressure on both occasions was normal.

If we believe that the peculiar features of acanthosis nigricans, viz., the tendency to papillomatosis, both diffuse and discrete, the increased pigmentation, and the pruritus—in the cases associated with malignant disease—are due to involvement of the abdominal sympathetic, the question arises whether slighter forms such as this may not result from other factors affecting the sympathetic nervous system. The provoking factor in this case would seem to be the shock, which preceded the onset of symptoms by a few weeks. The hypothesis put forward by Bloch that the papillary hypertrophy is due to some substance formed in certain forms of malignant disease seems to me untenable, as it does not account for the pigmentation or for the undoubted cases of acanthosis nigricans in which no malignant disease is present.

Fox Fordyce Disease.—G. B. DOWLING, M.D. and LOUIS FORMAN, M.D.

Miss M. W., aged 46, began three years ago to complain of severe irritation on the vulval region and in the armpits, followed by the appearance of an eruption. Her menstrual periods had ceased just before the irritation—which is severe enough to keep her awake at night—commenced. She has always been "nervy" and the other members of the family are highly strung.

She is thin, of poor physique, and neurotic. The general examination is negative but the blood-pressure is very low, 90/60.

The skin of the lower abdomen and the groins is pigmented, but there is no definite lichenification. Small flat papules, a little darker than the normal skin, are seen over these areas, more closely grouped above the pubes and in the groins. The axillæ are pigmented and numerous small papules, some conical and pierced by hairs, are to be seen, particularly over the anterior folds. A section from the axilla and the abdomen shows some slight acanthosis, and the sweat glands in the dermis are much dilated. They appear to correspond with the apocrine glands described by Schiefferdecker. The lining cells are flattened, some are seen distended with clear secretion, others are swollen with granular protoplasm, and some are desquamated into the lumen of the gland.

The dilated sweat glands are collected in groups and surrounded by a moderate infiltration of plasma cells and lymphocytes. The glands are in state of activity, and this would suggest that the cyst-like appearance is not due to mechanical obstruction of the ducts, described by Professor Fordyce in his orginal description of the disease. Kyrle states that the apocrine glands, which in women are numerous around the pubis, lower abdomen, perineum and the axillæ, function both by secreting into the lumen as in the ordinary sweat or eccrine glands, and also by throwing off portions or the whole of some of the lining cells, as in the sebaceous glands.

This change has made its appearance unusually late in this patient, at the menopause, and this supports the view that the overactivity of these secondary sexual glands is due to the disturbance of function of the recognized endocrine glands.

Dr. Dowling said that in the great majority of the published cases the patients had been between the ages of 14 and 30; only one or two post-menopausal cases had been described.

A second interesting and unusual feature in this case was the wide distribution of the eruption, covering, as it did, in addition to the usual areas, the greater part of the lower abdomen.

? Pustular Psoriasis : Case for Diagnosis.—J. M. H. MacLeod, M.D.

Patient, female, aged 60, at the age of 5 had a scaly eruption all over the body, of the exact nature of which she was unaware. In August, 1929, her left leg became tender and scaly patches appeared on her face. This was followed by a generalized scaly eruption, which lasted for a month and disappeared, except for areas on the left eye and left leg.

In January, 1931, an ulcer developed on the calf of the left leg and persisted up to the time of the patient's admission to St. John's Hospital in December, 1931.

On admission.—Red, slightly raised moist scaly areas on left eyelid, bridge of nose, chin, and forehead; two small patches on the back; small patch on right knee, covered by a thick white crust. On the leg there was a deep ulcer about the size of a half-crown, the skin around which was deeply inflamed and raised. Surrounding the ulcer and extending to the front of the leg were slightly raised, deep red, glazed areas which became covered with a scaly crust if untreated. There was also a small lesion on the left elbow and three lesions on the fingers, which were covered by silvery scales, easily removable.

A biopsy was made from the lesion on the leg, and the sections showed a lengthening of the interpapillary processes of the epidermis, parakeratosis associated with leucocytic infiltration, and here and there collections of pus cells forming minute pseudo-abscesses. The vessels of the papillary and subpapillary layers were dilated, and there was a widely spread infiltration of inflammatory cells most marked in the neighbourhood of the vessels.

The diagnosis of the case was difficult, owing to the co-existence of the raised ulceration on the leg with the moist scaly eruption elsewhere. The Wassermann reaction on January 14, 1932, was negative, and the conclusion arrived at was that the ulcer was independent of the eruption elsewhere, which was mainly pustular psoriasis.

Discussion.—Dr. H. W. Barber said he thought that the condition was mycosis fungoides.

Dr. A. C. Roxburgh said he agreed with Dr. Barber that, clinically, the case was one of mycosis fungoides, but he did not think that the histological report supported that view.

Tuberculides of the Acnitis Type and Commencing Lupus Erythematosus.—J. M. H. MacLeod, M.D.

Patient, a woman aged 26 years, has suffered since May, 1931, from the present eruption which appeared after the extraction of some teeth. It began on the right eyebrow, spread rapidly on to the nose, cheeks, back, arms, and chest, and reached its present state within a week of the onset. Since then it has remained unchanged.

There is no history of any previous skin affection. The majority of the lesions are of the acnitis type. Some of them have enlarged so as to form small patches, the largest being about the size of a finger-nail, scaly in the centre, with a permanent red inflammatory halo. Scars are also noticeable where lesions had involuted. The larger lesions are suggestive of commencing lupus erythematosus.

The patient has had recurrent attacks of tonsillitis and rheumatism, and on one occasion developed purpura hæmorrhagica.

There is no personal or family history of tuberculosis, and the patient presents no tuberculous stigmata. The Wassermann reaction is negative. The case is of interest owing to the development of typical tuberculide lesions into lesions suggesting commencing lupus erythematosus. The association of this eruption with tonsillitis and rheumatism points to the possibility of its being of streptococcal origin, but a cutaneous streptococcal test, with 25 million injected intradermically, was negative. One of the lesions was excised and had the following characteristics: Focal infiltration about the vessels in the subpapillary layer, hair follicles, and sweat glands, with a few plasma cells, but no giant cells. Epidermis unaltered except in the centre, where there is necrosis.

Bowen's Disease with Prickle-celled Carcinoma and associated with Psoriasis.—W. N. GOLDSMITH, M.D.

A. G., female, aged 60.

Present condition.—On the right thigh is an oval lesion about 2 cm. long. It is fairly sharply defined, but has no raised edge or deep infiltration. The horny layer is broken up and here and there are little dark scabs. When these are removed a smooth surface is left which sometimes secretes a little sticky fluid. On the inner and posterior surface of the same thigh is a deep scar.

History.—Since childhood, intermittently, she has had scaly patches on different parts of the body. There have been intervals as long as fifteen years between attacks. Some such patches were present when I saw her in September, 1931, and appeared to be psoriasis. They have recurred occasionally since but always respond quite easily to cignolin or other anti-psoriatic remedies. For the last three years she has had a different kind of lesion which on cursory observation rather closely resembles the psoriasis patches. But the new lesions proved more persistent and were slightly itchy, and the patient says that on scratching off the constantly recurring scabs, a little sticky secretion is noticed. These features enable her to distinguish the two kinds with certainty. The lesion on the right thigh, which has been present for for about two years, is a good example of the second type.

After treatment by ultra-violet radiation in 1929 a large oozing lesion developed on the right thigh.

On examination, August, 1930.—On the inner surface of the right thigh was a granular, red, moist tumour. On the left breast, behind the left ear, on the left clavicle and on the right thigh were lesions like the present one. A biopsy of the left breast lesion showed changes characteristic of Bowen's disease. A later biopsy, shown under the microscope, of a similar lesion in an early stage from the left thigh was made on 10.10.31. This showed clearly the characteristic features of Bowen's disease.

Over a considerable length of the epidermis the whole thickness of the mucous layer is largely disorganized. The cells vary enormously in size and shape and many are distended by great vacuoles and the nuclei are clumped. There is apparently no desmolysis between the cells as in Paget's disease. The basal-cell layer seems to be less disturbed than the more superficial strata and, tracing the section from the normal surrounding epidermis towards the lesion, one sees the first vacuolated cells quite high in the prickle-cell layer.

A biopsy of the thigh tumour, 26.8.30, revealed under the microscope the following structure:

Complete disorganization of epidermis which contains many large vacuolated cells and several parakeratotic pearls. Epithelial down-growths are not sharply defined and seem to fill blood-vessels and lymph spaces. Many of them contain a large number of vacuolated cells of the same type as are seen in the early non-neoplastic lesion. There is a dense inflammatory reaction composed of small lymphocytes and plasma cells.

The Bowen patches on the breast, neck, etc., were rapidly cured by X-rays and have not so far recurred. As regards the epithelioma, the condition was improved greatly by X-rays, but an indolent ulcer resulted and would not heal. The area was therefore electro-coagulated by diathermy, 22.8.31, the wound healing soundly. The present lesion on the right thigh has been treated with carbon dioxide snow, but with little effect.

Comment.—Clinically the rather hard, dark scabs and slight secretion differentiate the Bowen patches from psoriasis. This association is interesting in view of the number of cases described by Sir E. Graham Little and Dr. Gray, in which benign erythematoid epithelioma was associated with psoriasis. The histology of my case differentiates it sharply from benign erythematoid epithelioma. The fact that the earliest vacuolated cells seem to form in the superficial layer of the rete, considered in conjunction with the prickle-celled epithelioma, is rather at variance with Kreibich's view that the Bowen cells are derived by anaplasia from the basal cells.

Treatment.—Bowen and Darier found radiotherapy uncertain. In this case X-rays have been very effective for the non-cancerous lesions, whilst carbon dioxide snow, recommended by Bowen, has failed.

Discussion.—Dr. J. H. T. DAVIES said he thought that it was incorrect to call this an example of Bowen's disease, since the lesions originally described by Bowen consisted of crusted warty papules, of circinate arrangement, which left scars, giving an appearance like that in chronic tuberculosis verrucosa. The lesion on the thigh in the present case had a rolled edge. He thought it was benign erythematoid basal-celled epithelioma of the Graham-Little type, and that view was confirmed by the section. There were masses of new epithelium growing within the Malpighian layer, and the cells were of the deeply-stained type characteristic of intra-epithelial basal-celled growth. There was some dyskeratosis, but this was unlike any seen in genuine Bowen's disease.

Dr. GOLDSMITH, in reply, said he did not agree that there was a rolled edge. He could not see a trace of one in this or any of the earlier lesions. The histology of this case was, he contended, absolutely characteristic of Bowen's disease as interpreted by Darier, Jessner and others, i.e., there was disorganization of the whole depth of the epidermis, great inequality of the size of the cells, and conspicuous vacuolation and clumping of the nuclei, without retraction from cell-network. The basal cells seemed to him to be relatively less affected.

Two Cases of Pustular Psoriasis with Arthritis.—ELIZABETH HUNT, M.D.

(I) The first patient, G. B,, aged 51, has, since the age of 12, suffered from psoriasis, confined almost entirely to the elbows and knees. She has never been quite free, though at times the condition has almost cleared. About ten or twelve years ago she began to have " rheumatism " in her joints. This began with swelling and pain in the small joints of one hand; then the other hand was affected and, one by one, the wrists, ankles, knees and shoulders became involved. Eighteen months ago the skin lesions became more active and began to spread more widely over the arms, legs and trunk. At the same time lesions appeared on the soles of the feet and on and between the toes, which " looked different " from the original psoriasis. With the onset of this eruption the pain and swelling in the joints became slightly less.

Except for a history of ? slight tonsillitis two years ago, patient has otherwise been healthy. The menopause occurred two years ago. There is no family history of rheumatism or skin disease.

When seen in October, 1931, she presented the typical picture of rheumatoid arthritis, the fusiform swellings of the small joints of the hands with ulnar deviation of the fingers, swelling of the wrists, knees and ankles, with marked limitation of movements. Small patches of chronic psoriasis were present on the arms and back and legs. The nails of the hands were pitted, furrowed and deformed. The soles of the feet were symmetrically affected with an erythematous scaling eruption in which pustular patches were present. This eruption covered the soles and extended on to the sides and heels. The clefts of the toes were macerated and deeply fissured. The whole appearance of the feet suggested a mycotic infection. Microscopical examination of scrapings was however negative.

Physical examination revealed numerous extrasystoles, but no other cardiac lesion.

X-ray report.—No lipping. No changes in bone structure. No irregularity of articular surfaces.

Under internal and local treatment the skin condition has improved considerably, and the arthritis has diminished, but both are still active.

(II) The second patient, A. C., aged 62, consulted me in February, 1931, on account of the condition of her hands and feet. There is no clear history of psoriasis in this case, but the statement that she has always suffered from a "dry skin" is suggestive. In November, 1929, she had an attack of rheumatic fever. During convalescence a slight eruption of psoriasis developed on the hands; later this affected the feet, elbows and knees, and gradually became more acute on the hands and feet.

At the age of 16 she had a first attack of rheumatic fever and has suffered from rheumatism at intervals since that date. Her mother and her maternal grandfather suffered from "rheumatism in their joints."

The condition of this patient has improved noticeably under treatment.

At the first consultation the hands and feet were symmetrically affected with an erythematous scaling eruption and numerous superficial ulcerated lesions pinhead size. The parts chiefly affected were the palms and the tips and sides of the fingers. On the feet a similar eruption was present, extending on the right foot to the heel—the tips and sides of the toes were markedly involved—and painful fissuring of palms and toes was a constant feature. On the right knee was an erythematous scaling plaque of psoriasis and small typical psoriasis lesions were present also on the left knee and the elbows.

At present the acute condition of the hands and feet is much relieved, but the scaling and fissuring still continue, though to a much lesser extent.

X-ray report—Slight arthritic changes visible in the terminal phalangeal joints of the right hand. Otherwise negative.

Comment.—The diagnosis of pustular psoriasis in these two cases has been based on the grounds which Dr. Barber defined in the discussion on "Acrodermatitis Perstans and Pustular Psoriasis" at the 1930 (Annual) Meeting of the British Association of Dermatology and Syphilis, viz., the clinical character of the eruption, the site of election on the palms and soles, the development of the pustular lesions on the scaling erythematous areas, the association with lesions of psoriasis elsewhere on the body, and the negative results of the examination of scrapings.

With regard to the arthritis which is so prominent a feature of both cases, the clinical outlines of the cases do not fit with exactitude into the picture of psoriasis arthropathica drawn by Garrod and Evans.[1] The perplexing question forces itself whether the arthritis and the psoriasis are due to a common cause, or whether the first case is a case of chronic psoriasis in which an exacerbation of the condition has occurred at the menopause, as is often observed, and this has been further complicated by rheumatoid arthritis. Both these patients themselves believe there is some association between their skin lesions and their joint affections, and both have remarked independently that the pain and stiffness in their joints varies with the condition of their skin.

In the second case there is a clear history of rheumatic infection since girlhood.

At a recent meeting of this Section Dr. W. J. O'Donovan spoke of the frequency of a familial association of psoriasis and rheumatism, using the term "rheumatism" to embrace all its varied clinical manifestations.

If we accept the view that rheumatism is a manifestation of streptococcal infection, the question naturally arises whether the psoriasis lesions in rheumatic patients are evoked by the same cause. Experimentally, Clawson[2] has demonstrated that the result of injecting streptococci subcutaneously is the production of nodules which are morphologically similar to the nodules found in the subcutaneous tissues in cases of acute rheumatic fever. A comparison of the histological characteristics of such nodules and the psoriasis lesion shows an extraordinary number of points of similarity. In both there is (1) at first an exudative reaction—œdema—congestion of vessels. This is followed by a leucocytic infiltration, chiefly mononuclear in the early stages, later polymorphonuclear. (2) A proliferative reaction, varying in type with the type of the cell tissue in which it takes place. In the case of the rheumatic nodule, connective-tissue and reticulo-endothelial cells proliferate. In the case of psoriasis, the cells of the rete Malpighii. (3) In both the reaction may pass on to the formation of abscesses. These abscesses may be abortive or, under certain conditions, may become definite. In psoriasis we are ignorant of the causes which lead to the definite formation of abscesses—we only know that, when clinically pustular lesions are demonstrable, the histological picture shows a more extensive leucocytic exudation. In the case of the experimental rheumatic nodule, Clawson has shown that abscesses occur in the normal or immune animal when larger doses are given.

In the hypersensitive animal, however, a different set of conditions exists. Doses which in normal or immune animals have no noticeable effect or produce only very small, firm polyblastic nodules will, in the sensitized animal, stimulate the production of definite nodules, many of which are extreme enough to be definite abscesses. This finding would seem to be of special practical interest to the dermatologist in the elucidation of the problem of psoriasis and its association with arthritis and rheumatism.

The existence of a quantitative relationship between allergy and the polyblastic type of reaction which occurs in psoriasis and in rheumatism and experimental streptococcal lesions would help to explain the pathogenesis of the lesions in many cases of psoriasis and rheumatism. It would explain the recorded cases of recurrent attacks of psoriasis and arthritis, and would afford an explanation of the many and varied causes which appear to influence the onset of an eruption of psoriasis, e.g., trauma, disturbances of the sympathetic nervous system, exhaustive conditions, pregnancy, parturition, lactation, the menopause. It would explain in these two

1 Garrod and Evans, *Quart. Journ. Med.*, 1924, xvii, p. 171.
2 Clawson, *Annals of Internal Med.*, vol. iv.

cases which I present the association of the more acute types of psoriasis lesion with, in the one case, rheumatoid arthritis, which in the last year has been shown to be due to a streptococcal infection, and in the other case, an old rheumatic history.

Congenital Hairy Tuft associated with Spina Bifida Occulta.—J. E. M. WIGLEY, M.B.

An otherwise perfectly healthy and normal boy, 3 years and 9 months of age, has a tuft of fair silky hair, of the same texture as that on his scalp, growing to a length of 9 in. from a lozenge-shaped area in the small of the back. The skin from which this tuft is growing appears quite normal, and is not different in colour from the surrounding areas. A radiogram shows definite evidence of spina bifida, affecting the last dorsal and first lumbar vertebræ. The question is whether it is justifiable to risk the atrophy and telangiectases, which must almost inevitably ensue, by attempting to epilate the area permanently with X-rays.

? Papillomatosis Pigmentata (Gougerot-Clara-Bonnin type) [1].—J. H. T. DAVIES, M.B.

Charles W., aged 10, was brought to me about a month ago by his mother, who complained that his neck could not be washed clean. The condition had been first noticed about two years ago, when his neck and the inner surfaces of the thighs became rough. The condition was treated as eczema, and the roughness disappeared, leaving behind it pigmentation; presently the pigmentation faded and the roughness reappeared. Then the roughness disappeared spontaneously, and was followed, as before, by pigmentation. This sequence has taken place several times, and each time the condition has become more marked. Last spring the eruption appeared on the backs of the hands, and the mother remembers that in this situation its onset was associated with some vesicles containing clear fluid; she is quite sure that this phenomenon did not occur elsewhere. The eruption has only given trouble subjectively when more than usually violent attempts have been made to wash his neck. Unfortunately, the condition has not escaped the notice of his schoolmates, and the boy is becoming sensitive about it.

On examination.—The face appears to be unaffected. On both sides of the neck, and, to a less extent, directly in front and behind, there is an eruption consisting of warty papules entirely irregular in size and form, but not exceeding 3 mm. in diameter, and nowhere confluent, being separated from one another by the natural markings of the skin. Associated with these warts, but not entirely corresponding either with them or with the spaces between them, is a brownish-black pigmentation. Over the sternal notch there are three or four pigmented spots, not associated with warts. On the forearms the eruption exists in an attenuated form. The backs of both hands and of the two proximal phalanges of all the fingers are densely covered with the eruption, and on the dorsal aspect of the proximal phalanx of the fifth finger of the right hand is the largest lesion which has been observed, and its appearance strongly suggests an early cutaneous horn, being a dome-shaped papule surmounted by a truncated cone of laminated horny material. On the palms of the hands and the soles of the feet, when first examined, were numerous lesions consisting of minute, pitted depressions which, but for their manner of distribution, which was irregular, faintly suggested porokeratosis punctata. At the present moment the sites of these punctate depressions are filled with horny material, and they now resemble multiple, very small, plantar warts.

On the inner surfaces of the thighs is a condition resembling that on the neck, but it is not so pigmented.

An X-ray exposure was given to the left side of the neck, and three weeks later it was found that to some extent the warts had disappeared, but the pigmentation was markedly intensified.

It has been suggested that this is a case of Darier's disease, but I think the distribution is the reverse of that of Darier. Instead of affecting the coarse greasy skin in the trunk and on the side of the nose and forehead, it has selected the thin dry areas on the sides of the neck and the inner surface of the thighs. The decision will possibly be easily made when sections have been examined microscopically.

REFERENCES.

[1] *Bulletin Soc. Franc. Derm.*, 1919, xxvi, 218. [2] *Archives Dermato-Syphiligraphiques*, 1929, i, 102, GOUGEROT et CARTEAUD, "Papillomatose papuleuse confluente et réticulée."

Discussion.—Dr. W. N. GOLDSMITH agreed with Dr. Davies that this was not Darier's disease; the individual lesions lacked the hardness and conical shape. But he did not agree that involvement of the sides of the neck was an argument against Darier's disease. In a case which he, the speaker, had shown at a meeting of the Section and which was generally accepted as quite typical clinically and histologically of Darier's disease, the sides of the neck were severely attacked, as also the axillary groins and lower part of abdomen.

Dr. DAVIES (in reply) said he did not think that the lesions were follicular; they lay indifferently about and between the follicles.

POSTSCRIPT.—Microscopical examination confirms the diagnosis of Darier's disease.

An Unusual Condition of the Gums, associated with Mild, Intractable Cheilitis: Case for Diagnosis.—J. H. T. DAVIES, M.D.

This patient consulted me in March 1931, with a story that six months previously he had bitten his lip and that it had failed to heal.

On examination.—There was a fissure in the upper lip, in the middle, and at each side the lip was peeling in large flakes. Removal of one of these, which was somewhat adherent, revealed an erosion with a papillary surface. The fissure was fairly easily healed by painting with silver nitrate. A mild sulphur and tannic acid ointment had a temporary effect on the cheilitis. An exposure to X-rays—one-third B—had no useful effect.

At the same time, I noticed that the gums of the upper jaw, over a sharply limited area a few millimetres above the insertion of the teeth, but fading diffusely into the natural surface of the buccal surface of the upper lip, there was a bluish-grey area having a finely pitted surface. There was a minute, conical tag on the frænum, the tip of which was similarly affected, and this I removed for microscopical examination; unfortunately it shrank so much in the process of embedding that the sections were useless.

The Wassermann test has not been made.

Discussion.—Dr. H. C. SEMON said that he regarded the lesions as leucoplakic in type.

Dr. PARKES WEBER suggested that the condition in the patient's upper jaw gum-surface was a kind of leukoplakia, whether there had been any syphilis or not, and there was just a question as to whether it might predispose to carcinoma later on.

? Lupus Erythematosus: Case for Diagnosis.—H. C. SEMON, M.D.

For the last four years this patient has had an eruption on the backs of her hands and feet. I saw her for the first time in October, 1931, when I made a tentative diagnosis of lupus erythematosus. This I based on the fact that the lesions were symmetrical, the colour was that associated generally with lupus erythematosus, and the subjective sensations corresponded with what is usual in such cases. I was perplexed by the absence of atrophy after four years of symptoms. The therapeutic test with gold was successful. Six injections of solganal were given intramuscularly, and in seven or eight weeks the lesions had completely involuted. They relapsed, however, after five weeks.

The President showed a somewhat similar case at a recent meeting of the Section, and this patient is shown with a view to comparison, and also to give me an opportunity to urge the greatest care in the administration of gold preparations—whether given intravenously or by the intramuscular route. The same drug that cleared the symptoms (temporarily) in this patient, was given in the same ascending doses (0·01, 0·05, 0·1, 0·25, 0·5, and 1 grm.) in another case of lupus erythematosus, on the makers' assurance that there was no risk of dermatitis, etc. The patient developed an acute exfoliative dermatitis, from which she very nearly died.

I am in entire agreement with those who do not raise a small preliminary dose as long as it appears to be doing good, although on the other hand it is not easy to lay down a maximum, as tolerance varies considerably. In this particular case, which relapsed so soon after treatment, it is proposed to adopt Dr. MacCormac's suggestion of bismuth injections (quinine-bismuth-iodate).

Discussion.—Dr. A. C. ROXBURGH said that, in his experience, bismuth injections were as effective as those of gold, and much safer. He used a suspension of metallic bismuth in glucose.

Dr. WIGLEY said he regretted to hear that Dr. Semon had been discouraged in the treatment of lupus erythematosus by gold, for he personally found that the method of giving gold advocated by Dr. Haxthausen had given satisfactory results. Gold chloride was used in solution, and a small dose was given. The dose was not increased so long as there were any evidences of improvement. It might be called the "optimum" dose, and was given at weekly intervals at first, then at fortnightly intervals, later at intervals of three weeks, and still later at monthly intervals. This was continued as long as possible (he had kept it up for from six to nine months with benefit). Unfortunately, when the injections were discontinued there was frequently a relapse.

Dr. JOHN FRANKLIN said he considered that one course of injections was inadequate even if it cleared up the lesions. Treatment should be continued for at least eighteen months, and should be divided into two or three courses of from eight to ten weekly injections, with suitable rest intervals between the courses.

Dr. NORMAN BURGESS said that for the past three years he had treated cases of lupus erythematosus with small doses of sanocrysin, beginning with 0·01 of a gramme and gradually increasing the dose to 0·05 grm., and in some cases 0·1 grm. weekly. In his experience these doses could be continued at weekly intervals for long periods, and he had never seen untoward results. The results of treatment were as satisfactory as those obtained by the administration of larger doses of gold compounds.

Dr. H. T. BARRON said that during a considerable experience of treating lupus erythematosus with gold compounds, the only unpleasant results he had ever seen had been due to overdosage. Even the scale of doses given by the makers of the preparations was, in his judgment, too heavy.

Lymphangioma Circumscriptum. — H. MacCormac, C.B.E., M.D., and C. P. Wilson, F.R.C.S.

The patient, a girl aged 13, first noticed the lesion two years ago. On the right side of the palate there is a patch of clear vesicles, a few of which are red and contain blood, a typical example of lymphangioma circumscriptum. There is an occasional slight discharge of blood and sometimes a sore throat, otherwise no inconvenience is experienced.

Section of the History of Medicine.

[*January* 6, 1932.]

Alcmaeon of Croton: His Life, Work, and Fragments.

By PAN. S. CODELLAS, M.D.

CROTON became a medical metropolis through the distinction of its medical school and the ability of its doctors, of whom Democedes is one of the best known. This famous physician came to Croton from Cnidus in 530 B.C., and remained there until 525 B.C., when his services were retained by Athens as State physician.

In another sphere than medicine, but one which at that time had more than a superficial connection with medicine, namely, philosophy, Croton is distinguished by its association with Pythagoras, who migrated to that city from Samos. Pythagoras introduced philosophical methods into medicine, and was at pains to reason out and explain the causes of disease. His medicine was preventive rather than curative, and resembled in principle the contemporary medicine of Egypt and Babylonia. Iamblichus gives the main features of Pythagorean medicine (*Vit. Pyth.*, §163), where he says: "Of the sciences they honour more Music, Medicine, and Augury; the kind of medicine they chiefly emphasize is the dietetic . . . They make greater use of poultices than did their predecessors. Drugs are employed to a less extent and only on ulcers. . . . For some ailments they use incantations, also music, as being beneficent to health if properly so used. At times it was accompanied by Homeric or Hesiodic verses for "psychic complaints." The Pythagoreans were interested in Generation and Decay, Vision, the nature of the Sperm, the possible production of Sperm by the Female, and Embryology.

Knowledge of Alcmaeon himself and of his works is very meagre and debatable, and the account which follows here is gathered together from scanty fragments which have survived in literature and tradition. His name is variously given as Alcmaeon, Alcman, Alcmaon or Alcmeon, the variations being largely explicable as dialectic forms. His father was Peirithus or Perithus. He was most probably born at Croton; at all events he lived in that city for a number of years.

A short parenthetic remark from Aristotle refers to the time in which he flourished, but is disputed by philologists. Pythagoras must, however, have been an old man when Alcmaeon came of age or came to him. This view is reinforced by the statement of Iamblichus (*Vit. Pyth.*, §104) that "disciples of Pythagoras in his old age were the young men Philolaus . . . and Alcmaeon." This is further corroborated by the text of Asclepius, Aristotle's commentator (Hayduck, p. 39, 21). The flourishing period of the school of Pythagoras was 532 B.C., so that Alcmaeon may be placed in the latter half of the sixth century B.C.

Of Alcmaeon's family nothing is known except the name of his father; of his early or later schooling nothing. He may have been a Pythagorean, but his natural bent was towards things of more practical import than abstract thought.

According to Clemens of Alexandria (Strom. I, 26, 78) and Favorinus (referred to by Laërtius), he was the first to write natural history, but this view is not supported by the extant Greek literature.

His writings are naturalistic, astronomical, psychological and biological. Laërtius remarks that the contents of his books are for the most part medical, although he also wrote on nature. Fragment II of the present collection contains the opening of one of Alcmaeon's books and suggests also the title.

He must have written several books, if one correctly interprets Galen and Laërtius; the latter writer enumerates the books of Aristotle, among which is one

bearing the title, "Against the Works of Alcmaeon." It appears to have been of polemic nature, and is among the lost works of Aristotle.

Theophrastus seems to have possessed a complete knowledge of Alcmaeon's writings and his quotations lead one to suppose that he follows Alcmaeon's order. Alcmaeon wrote in mixed Doric and Ionian dialect.

Modern writers, accepting the comment of Chalcidius (*Tim.* 244): "primus exsectionem aggredi est ausus," call Alcmaeon "Father of Human Anatomy." He recognized, at all events, the Eustachian tubes and the acoustic nerves, and was the first to practise anatomy by cutting off organs and dissecting them. It is also true that he made "the earliest records of anatomical observations" (Singer, p. 9).

FRAGMENTS.[1]

I. Metaphysics.

(i) *Differentiation of man and animals.*

Theophrastus, *De sensu*, § 25 (Dox. 506, 19) "Alcmaeon, one of those who do not regard sense perception as similar (to thinking), first points out the difference from animals. He says that man differs from other animals, because he alone comprehends, while the other animals perceive but do not understand, because understanding and perception are different things, contrary to what Empedocles states."

(ii) *Divine and human knowledge.*

Laërtius, *Diog.* VIII 83.

(iii) *Dualism of opposites.*

Arist., *Metaph.*, A 5, 986 a 22.

Alexander Aphrodisiensis ad 1, 1 (pag. 42, 3 Hayduck).

Asclepius ad 1, 1 (pag. 39, 21 ed. Hayduck).

Isocrates (Or. 15), § 268.

(iv) *Immortality Circle.*

Arist., *Problem.* XVII 3, 916 a 33.
Michael Apostolius, *Proverb. Cent.* XVIII 50 (*Corpus Paroemiogr.*, ed. Leutsch et Schneidewin II 674).

(v) *Immortality of the Soul.*

Arist., *de An.*, I 2, 405 a 29.
Simplicius ad 1. 1. (pag. 32, 3 Hayduck).
Sophonias 1. 1. (pag. 14, 31 Hayduck).
Themistius, in paraphrasi 1. 1. (II 24 Sprengel): "And Alcmaeon the Crotonian Naturalist, stated, similarly to these, that it (the soul) is immortal through being similar to the immortal objects, by moving for ever, because it and all the others are moving continuously, sun, moon, stars, heaven."
Laërtius, *Diog.* VIII 83.
Cicero, *De nat. deor.*, I 11.
Clemens, *Alexandr. Protrept.*, V 66.
Boëthus, *apud Eusebium praepar. ev.*, XI 28.
Arist., *de An.*, I 2, 404 a 20.
Sophonias (11, 25 Hayduck).
Philoponus, *ad Arist. de An.*, I 2, 404 a 20 (page 71, 6 Hayduck).
Stobaeus, *Ecl. Phys.*, I 52 (Dox. 386 b 4) ex Aëtio.
Theodoretus, *Cur. graec. aff.*, 5 (pag. 195 Gaisf.) ex eodem Aëtio.

1 Only those of medical interest are given in full; the rest are given by reference.

II. ASTRONOMY.

(vi) *Sun.*

Stob., *Ecl. phys.*, I 25 (Dox. 352 p 8) ex Aëtio.

(vii) *Eclipse of the Moon.*

Stob., *Ecl. phys.*, I 26 (Dox. 359 b 17) ex Aëtio.

(viii) *Planets.*

Aëtius, *Plac.*, II 16, 2. 3 (Dox. 345 a 19, b 22).

(ix) *Stars.*

Arist., *de An.*, I 2, 405 a 29.
Laërtius, *Diog.* VIII 83.

III. ETHICS.

(x) (*Ps.*—) *Alcmaeonis fragmentum ethicum.*

Clemens Alexandr. Strom. VI 2, 16 (III 106 Klotz).

IV. EMBRYOLOGY.

(xi) *Origin of Sperm.*

Plut., *Epit.*, V 3, 3 (Dox. 417 a 10) ex Aëtio: "Alcmaeon (states that the sperm is) part of the brain."

Censorinus, *D. d. nat.*, V 2, 3: "Some refute this opinion, as Anaxagoras, Democritus, and Alcmaeon the Crotonian (that the sperm is derived from the marrow).

(xii) *Maternal Sperm.*

Censor., *D. d. nat.*, 5, 4: "That also makes the question ambiguous among authors, whether offspring is born from the semen of the father only, as Diogenes and Hippon and the Stoics wrote, or from some seed in the mother also, as is accepted by Anaxagoras and Alcmaeon and Parmenides and Empedocles and Epicurus."

(xiii) *Sex determination.*

Censor., *D. d. nat.*, 6, 4: "Alcmaeon said, the sex of that parent is represented, from whom comes a greater quantity of sperm."

(xiv) *Sterility of Mules.*

Plutarchus, *Epit.*, V 14, 1 (Dox. 424 a 30) ex Aëtio:—"Alcmaeon has said that of the mules the males are sterile on account of the thinness (and) coldness of the sperm, the females because their uteri do not "open their mouths wide enough. This was his own expression."

(xv) *Nutriment of the Chick.*

Arist., *De gen. an.*, III 2,752 b 22:—"The viviparous animals produce the food for the young, which is called milk, in another part (of the body), in the mammæ; in the birds this is made by nature in the eggs. It is, however, the opposite to what men think and what Alcmaeon the Crotonian states: the white (of the egg) is not the milk, but the yellowish part. This is the food for the chick. People think that the white is the food because of the similarity of colour."

(xvi) *Foetal Nutrition.*

Plut., V 16, 3 (Dox. 426 a 28) ex Aëtio:—Alcmaeon says that (the foetus) is nourished through the body: it takes up the nourishing parts from the food like a sponge."

Oribasius, III 156, edd. Bussamaker et Daremberg:—"From Rufus. The first nourishment that should be offered is some honey, for it acts as a stimulant by its sweetness, and besides, it clears the body right through as

well as the bowel. For at this period the bowel contains some residue which must be expelled: not, as Alcmaeon thinks, because the baby swallowed with its mouth while in the womb, for that is absolutely impossible."

(xvii) *Foetal Development.*

Plut., *Epit.*, V 17, 3 (Dox. 427 a 8) ex Aëtio:—"Alcmaeon (said) that the head in which resides the governing faculty (principatum), (is first completely formed in utero)."

Censor., *D. d. nat.*, V, 5, denies this statement, thus disagreeing with Plutarch.

V. DEVELOPMENT.

(xviii) *Puberty.*

Arist., *Hist. anim.*, VII 1 p. 581 a 13:—"Alcmaeon the Crotonian says that the male begins to produce sperm for the first time in the majority of cases on the completion of twice seven years; at the same time hair begins to grow in the pubic region, just as the plants preparing to produce seed first bloom."

(xix) *Mental Maturity.*

Schol. ad Plat. Alc. prior pag. 121 E (*Dial. Plat.*, ed. K. Fr. Hermann, VI 281): "Then (at the fourteenth year) perfect reason appears in us, as Aristotle and Zeno and Alcmaeon say."

VI. ANATOMY.

(xx) *Dissection.*

Chalcidius, *in Plat. Timaeum*, pag. 279, ed. Wröbel:—"The nature of the eyes has been demonstrated by Alcmaeon and several others. He was a well-versed naturalist and was the first to undertake dissection."

VII. SPECIAL SENSES.

(xxi) *Vision.*

Theophr., 1. 1. 26 (Dox. 506, 28):—"The eyes see by means of the wateriness about them, but it is evident that the eye contains fire, for a blow on the eye produces flashes. Sight depends on brilliancy and transparency of reflection, and the clearer this is, the more perfect (is vision).

Stob., *Ecl. phys.*, I 52 (Dox. 404 b 23):—"Alcmaeon states (that vision takes place) according to the degree of transparency."

(xxii) *Hearing.*

Theophrastus, *De sensu*, 25 (Dox. 506, 23):—"He (Alcmaeon) says that we hear with the ears because there is an empty space in them; this space resounds. Sound is produced by the cavity, and the air (in it) produces resonance.

Aëtius, *Plac.* 16, 2 (Dox. 406 a 21):—Alcmaeon says "that we hear by the empty space in the ears, because this is what resounds owing to the presence of the air; all hollow objects (*sic* Stob.: voids, Plut.) produce sound."

(Aristotle (*De an.*, II 8, 419 b 33) amplifies this idea that hearing is dependent upon empty space or cavity: hearing, he says, "is correctly attributed to emptiness, because air is thought to be emptiness.")

(xxiii) *Smell.*

Theophr., 1.1. (Dox. 506, 26):—"We smell through the nostrils by drawing up the air to the brain during inspiration."

Aëtius, IV 17, 1 (Dox. 407 a b 1):—"Alcmaeon says that the governing faculty is in the brain; through this we smell, because it draws up the savours by the breath."

(xxiv) *Taste.*

Theophr., 1.1. (Dox. 506, 26):—"We distinguish tastes with the tongue;

for being warm and supple it dissolves substances by its heat, and receives and distributes (the sensation of taste) in virtue of its porous and soft texture."

Plut. *Epit.*, IV 18 (Dox 407 a 12) :—Alcmaeon says " that determination of tastes depends upon the moisture and warmth which are inherent in the tongue in addition to its supple character."

(xxv) *Touch.*

Theophr., 1. 1 (Dox. 507, 3) :—With regard to touch he makes no statement as to the mode or means of its operation. Alcmaeon's exposition goes so far and no further.

(xxvi) *Cerebral Correlation of Senses.*

Theophr., 1.1.26 (Dox. 507, 3) :—(Alcmaeon states) " that all the senses are connected somehow with the brain so that when the brain is agitated and displaced, maiming (of limbs or senses) follows; since the passages, through which the sensations pass, are occupied."

VIII.—Physiology.

(xxvii) *Seat of Intelligence.*

Aëtius, IV 17, 1 (Dox. 407 a b 1) :—Alcmaeon says " that the governing faculty (hegemonic) is in the brain."

In chapter V, where Plutarch expounds the various sites which are given as seats of the ' hegemonic,' there is no opinion mentioned prior to Alcmaeon.

(xxviii) *Respiration of Goats.*

Arist., *Hist. an.*, I 1 pag. 492 a 14 :—" Alcmaeon is wrong in his belief that goats breathe through the ears."

(xxix) *Sleep, Awakening.*

Plut., *Epit.*, V 24, 1 (Dox. 435 a 11) ex Aëtio :—Alcmaeon says " that sleep results from retreat of the blood to the blood-carrying veins; awakening, by its pouring forth."

IX. Iatrica.

(xxx) *Origin of health and disease.*

Aëtius, *Plac.*, V 30, 1 (Dox. 442 a 3) :—" Alcmaeon states that the maintenance of health depends upon equilibrium of the faculties, moist and dry, cold and hot, bitter and sweet and so on, and that the predominance of any is productive of disease: for the predominance of any single one of them is disastrous. He says that disease occurs in some instances from excess of heat or cold, in some owing to excess or deficiency (Stobaeus has a *varia lectio* ' from excess of food ') and in some (from fault of) the blood, marrow or brain. With these must be included the occasional occurrence from extraneous causes such as qualities of water, soil or district or some unavoidable cause or things akin thereto. Health depends upon an evenly proportioned combination of qualities."

X. Death.

(xxxi) *Cause of death.*

Plut., *Epit.*, V 24, 1 (Dox. 435 a 11) :—" Total retreat (of blood to the blood-carrying veins) is death."

Alcmaeon's philosophical, biological, and medical opinions, whether specifically quoted as his or not, were the objects of discussion for about a thousand years, as it is shown from the extant Greek medical literature up to that of the 4th century A.D.

Many of his theories can easily be detected in the Corpus Hippocraticum.

In conclusion one may perhaps quote from Charles Singer's *Evolution of Anatomy* :—" Alcmaeon began to construct a positive basis for medical science

by the practice of dissection of animals. He discovered the optic nerves, and the tubes called in after ages (1562 A.D.) by the name of Eustachius. He even extended his researches to embryology, describing the head of the fœtus as the first part to be developed—a justified deduction from the appearances. Curiosity excited by him as to the distribution of the vessels led his followers, Acron (*c.* 480 B.C.), Pausanias (*c.* 480 B.C.), and later Philistion of Locroi (*c.* 390 B.C.), the contemporary of Plato, to make anatomical investigations."

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The History of the Introduction of Biochemistry into Medicine.

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[Abridged].

In the following account I have endeavoured to concentrate my subject into a small compass by laying stress on the recent rather than on the more remote past. Organic chemistry deals with the structure and relationships of the chemical substances to be found in animals and in plants; physiological chemistry dealt, it is true, with the changes such substances undergo in the living body, but did so largely by the study of the finished end-products, while biochemistry, in attempting to study those changes in relation to the tissue-cell, concentrates its attention on the internal medium of exchange—the blood—rather than on the secretions and excretions. Obviously no hard-and-fast line can be drawn, but I may illustrate my point by two examples.

However much I confined my remarks to the more recent past, it would, I am sure, be unnatural if I omitted to mention the well-known fact that Wöhler, in 1828, prepared urea in the laboratory, and thus, by making the first gap in the wall between the organic and inorganic compounds, dealt a shrewd blow at prevailing theories of vitalism. Organic chemists are interested in the fact that urea is carbamide, and that there are many substituted ureas; physiological chemists are interested in the formation of urea in the liver from amino-acids and in its excretion by the kidney, but a modern biochemist like Van Slyke is concerned with what he calls urea clearance, that is to say, a comparison between the concentrations of urea in the blood and in the urine, and the efficiency of the kidney in effecting that clearance.

In the same way it would be inexcusable if I omitted to note that Thomas Willis in 1679 discovered a saccharine substance in the urine of patients afflicted with the disease known since the time of the Greeks as diabetes. But this observation assumed a new physiological importance when Claude Bernard demonstrated the glycogenic function of the liver in 1857. The conditions modifying the excretion of sugar in the urine were closely studied by many clinicians, among whom Pavy calls for special

mention. Then a new biochemical era in the study of diabetes began about twenty years ago with the introduction of methods of estimation of the sugar in small quantities of blood. This quickly revealed the fact that the sugar did not run parallel in the blood and urine, the kidney evidently interpolating a resistance of varying degree. Hyperglycæmia rather than glycosuria was the enemy, and was much less under our control. Finally, with the discovery of insulin by Banting and Best came the means of controlling blood-sugar. This is an admirable example of a biochemical discovery, based as it was on a shrewd deduction from physiological observations, carried through by strict chemical procedure, and standardized by animal experiment.

Defined in this strict sense, biochemistry is indeed a modern subject. It sprang from physiological chemistry, but it owes much of its refined technique to pure chemists, who were not concerned with its practical applications. So true is it that knowledge sincerely pursued for its own sake ultimately brings gifts of great practical value. Medicine, beset by the clamorous demands of sufferers, ransacks the researches of chemists, physicists and physiologists alike, in its hunt for the means to help them. And thus it becomes the instigator of further scientific research. Paracelsus, that strange mixture of visionary, charlatan and searcher after truth,who is generally regarded as the father of physiological chemistry, was a practising physician. Discarding Galenic tradition, he taught chemical therapeutics, and mixed up with sallies which have been described as drifting "from the obscene into the incomprehensible," readers of his works profess to find the first foreshadowings of such modern ideas as asepsis, catalysis and evolution. It is, at any rate, certain that he gave us laudanum. His conception of the Archaeus as the essence of life was presented in a more orderly fashion by Van Helmont. One may see in his doctrine of Archaei the germinal idea of a sympathetic nervous system, controlling organic processes, but his discovery of carbon dioxide and his additions to our knowledge of digestive processes were of the greatest value. Yet, as Michael Foster pointed out, he was prouder of his speculative doctrines than of those practical achievements. A man is often strangely blind to his greatest merits, and desires praise for something else. He is regarded as the founder of the iatrochemical school which rose to its full height with Sylvius. Gamgee is very contemptuous of this school, and says: "Ignorant of the fundamental facts of chemical science the iatrochemists had attempted, but in vain, to explain the functions of the body entirely by reference to chemical operations and the actions of acids and alkalies and fermentations, etc. . . . Absurd as they appear to us, many of the doctrines of the iatrochemical school received the support of such men as the great mathematician and philosopher Descartes and our own anatomist Thomas Willis . . . who in spite of his thoroughly sound anatomical training was a credulous adherent . . . The futility, nay the absurdity, of the iatrochemists' attempts tardily forced themselves on the minds of men, and there arose a school which attempted to explain all the phenomena of the body upon mechanical principles"—the iatromathematical school, led by Borelli.

Here is an example of the unwisdom of premature attempts to state medicine in terms of chemistry or physics. It is a recurrent danger, and I venture to assert that there is to-day a tendency in certain quarters to push biochemistry to unjustifiable conclusions; indeed, a new school of iatrochemistry. In the same way, although to settle down under vitalistic hypotheses merely spells obscurantism, the equation and the graph are so mentally satisfying, things "come out" so neatly, that there is a distinct temptation to apply mathematics too soon to clinical work. Premature attempts in this direction convey an idea of accuracy which is not only wholly illusory, but actually delays progress by fitting facts to a mathematical formula. On the other hand, of course, it is true that the nearer a science is to correct mathematical expression, the more exact it will be.

Michael Foster is much kinder than Gamgee to Sylvius when he says that his attempts "pointed to the conclusion that it was unnecessary to take refuge in subtle influences and occult agencies, but that all the changes in the body were larger or more complex examples of the changes that could be produced in the laboratory." And he goes on to a specific instance when he says: "Reading between the lines by the help of the knowledge which we have gained since those days, we may find in Sylvius' words a prophecy of that limitation, in which we now believe, of the work of the kidney to the task of secreting, by mere elimination, the urea already formed in the tissues and carried to the kidney by the blood."

The reaction soon came with Stahl (1660-1734), whose teaching is thus summarized by Foster: "The events of the body may be rough hewn by chemical and physical forces, but the soul will shape them to its own ends . . . He thus stands forth at the close of the seventeenth century as the founder of 'animism,' which doctrine (though his 'sensitive soul' fell back later to the lower stage of 'a vital principle') maintained itself in many minds through the two succeeding centuries, and exists at the present day."

In one respect Stahl did a great disservice to physiology, for he formulated the phlogiston theory, and his authority maintained it long after his death. As Osler said, each of us inevitably trails about with him some of the error in which he was originally trained. No more striking example of this aphorism could be found than the idea of phlogiston, which again and again prevented researchers, such as Joseph Priestley in particular, from drawing correct deductions from their accurate observations. Yet once the theory lost authority, men wondered how it could have cumbered thought so long. When Lavoisier effected this overthrow, many observations fell into their place as at the touch of a magician's wand. And he could have done more but for his premature death by the guillotine.

But this is to anticipate. I do so to indicate how long it took physiological chemistry to escape from what Foster terms "the sterilizing influence of Stahl's animistic doctrines." For there had been earlier workers who had got near to the truths which Lavoisier enunciated a century later, but whose discoveries were neglected when Stahl's authority caused experiment to rank second to speculation. In the forefront of these must be placed John Mayow (1643-1679) of Oxford, whose memory Sheridan Lea used to honour, and to whose work Professor J. B. Leathes paid a notable tribute in the Harveian Oration of 1930. At the age of only 25 he had shown that there was something, which we now call oxygen, that formed only part of the atmosphere, and that was essential both for combustion and for all the chemical changes on which life depends. After this his health began to fail, and he died at the age of 35. Michael Foster says: "Had his body been as strong as his mind was acute, had he lived to that ripe old age which was reached by many another leader in science, how different would have been the story of chemical physiology."

Having thus attempted to define the issues, I must observe my self-imposed limits and deal with the history of the introduction of certain biochemical methods and ideas into the diagnosis and treatment of disease. Fascinating as were Stevens' experiments in 1777 with the stone-swallower, whom he induced also to swallow and regurgitate little perforated silver balls containing food-stuffs, thus enabling him to study their digestion, and biologically interesting as was John Hunter's discussion of the way the stomach was prevented from digesting itself, nothing gave such a clear picture of gastric digestion as Beaumont's classical observations on Alexis St. Martin in 1822. Two years later Prout, famous for the hypothesis indelibly associated with his name, proved the presence of hydrochloric acid in the gastric juice. The production of a mineral acid by living cells naturally excited surprise, and half a century elapsed before Maly put forward a plausible chemical explanation, which in a modified form still holds the field. It was not until 1883 that Leube

first employed the gastric sound in clinical work, and soon after this Ewald devised the method of the test breakfast. On this, until recent years, our ideas of the pathology of gastric secretion were based. By this method the absence of hydrochloric acid in cases of gastric carcinoma and its excess in cases of peptic ulcer were soon recognized. But the introduction of the method of fractional test meals, with which the names of Einhorn, Rehfuss, Bennett and Ryle are associated, has given us an entirely new point of view, dynamic rather than static, and therefore typically biochemical. Two interesting by-products of this work were the discovery of achlorhydria in 4% to 6% of apparently healthy individuals, and a clearer recognition of the great importance of the bactericidal properties of hydrochloric acid, to which indeed Bunge had, with considerable insight, attributed more importance than to its proteolytic action, in view of the greater potency of trypsin. These two lines of research have converged in a most interesting way, for which we are largely indebted to Hurst. An achlorhydric diathesis has been established as a factor in what I have ventured to call predestination in disease.

I shall not attempt to summarize the history of proteolytic processes, so laboriously studied by Meissner and by Kühne, but will draw attention again to two by-products which have proved extraordinarily fertile in enlarging our conceptions of disease. Pepsin was discovered by Brucke in 1861 and trypsin by Danilewski in the following year. Kühne's researches, which lasted from 1876 to 1883, showed that the protein molecule was much more profoundly disintegrated by the latter enzyme, and that it was this which was responsible for a colour reaction with bromine water, which since 1831 had been known to occur in the presence of pancreatic juice. Neumeister gave the name of tryptophan to this, merely implying that it was an indicator of tryptic activity. There the matter rested until 1901 when Hopkins and Cole isolated tryptophan and showed that it was an aromatic body which was an important constituent of many proteins, and gave rise to indol and skatol on bacterial decomposition. This might appear, though interesting, to be only of academic importance. As a matter of fact it was the starting point of researches of the greatest practical value, for in 1907 by depriving rats of tryptophan in their diet, Hopkins was able to show that they failed to grow. Hence the recognition of the importance of what he called accessory food factors, and thus to the discovery of that intensely active group of substances we now call vitamins. From the study of an obscure colour reaction to a knowledge which has revolutionized our conceptions and treatment of deficiency diseases is a far cry, but it is one which has been achieved within the present century.

The other by-product of the study of tryptic digestion has two main aspects. It was gradually realized that trypsin not only broke down proteins far below the stage of peptone into a large number of amino-acids, but that they could be grouped into hexone bases, mon-amino-fatty-acids, aromatic bodies, and others containing sulphur. This indicated that the rebuilding of such fragments into tissue protein was a complicated task far beyond the powers of the intestinal mucosa. The work of the liver in this connection became realized, and it was found that the greater part of the urea was exogenous in origin. This modified our conceptions of Bright's disease in several ways; among others it made the idea of an alimentary albuminuria untenable, though many medical men continue to deny eggs to their nephritics through a misunderstanding of D'Arcy Power's observations on himself in his undergraduate rowing days.

The second aspect of this by-product was also to prove of far-reaching importance. For when these protein building-stones were identified it was found that in certain circumstances they or intermediate products from them appeared in the urine instead of the normal end-products. It looked as if each needed its own special agent to break it down, and that this agent was an enzyme. It was found that the abnormal excretion of such substances was usually congenital and familial. On this foundation

Sir Archibald Garrod has built up his work on the inborn errors of metabolism. Such conditions as alkaptonuria, pentosuria, cystinuria, and porphyrinuria are admittedly rare and usually almost symptomless. But through them we have been taught to reinstate the conception of diatheses on a new and much more scientific basis, on the lines of Mendelian inheritance.

Turning from the external to the internal secretion of the pancreas, I may note that Thomas Cawley in 1788 described a case of diabetes in which the pancreas was atrophied and contained calculi, but it was almost ninety years later when Lancereaux showed that emaciated diabetics often had changes in the pancreas. Although Brunner had described the successful extirpation of the pancreas from dogs in 1682, it was left to von Mering and Minkowski in 1889 to note that such dogs became diabetic. Minkowski observed how the flies clustered round the urine of pancreatectomized dogs, and on testing found it to contain sugar. He and von Mering then proved that, if sufficient pancreatic tissue were left, the dogs did not develop glycosuria even when the pancreatic juice no longer reached the intestine. Lépine therefore, three years later, suggested that the appearance of sugar must be due to the failure of a glycolytic ferment which formed an internal secretion.

I should like at this point to recall a curious fact. Langerhans had described the pancreatic cell islets in 1869, yet in the year of Minkowski's discovery histological textbooks did not figure these islets. After Lépine's suggestion was made, Langerhans' original illustrations of 1869 came back into the new editions. So apt are we to set aside observations we cannot include in known categories. The history of science is full of such burials and resurrections.

The treatment of diabetes was a dismal story up to 1922. The first endeavour to make good the loss of sugar in the urine by its free administration in the food soon proved disastrous. Restriction of carbohydrate was then found to alleviate symptoms. But the search for an absolutely carbohydrate-free diet was illusory and disastrous. The association between it, ketosis and coma was gradually realized. Then began the hunt for carbohydrate in a form which the diabetic could assimilate, a qualitative rather than a quantitative restriction. With this phase the name of von Noorden is particularly associated. In 1914 Graham, noting that it was the low caloric value rather than the type of carbohydrate food which diminished the output of sugar, recalled Hurtley's purely chemical work indicating that much of the ketone bodies was exogenous in origin. This led him to the principle of alimentary rest, which was reached almost simultaneously by Allen in America by quite another road. We must not forget to give Guelpa credit for introducing a fasting method of treatment, even if it was based on an erroneous pathology and did not form part of a progressive system. To the latest and most triumphant phase of treatment by insulin I have already referred. It leads naturally to a consideration of the biochemistry of internal secretions.

The history of diabetes exemplifies the way in which the theory of internal secretion has always been in advance of the facts. The very name was introduced by Claude Bernard when the only known example was the glycogenic function of the liver. Brown-Séquard's hypotheses rested on but a small substratum of fact. The first internal secretion to be proved was that of the thyroid. Although thyroid feeding was employed in the previous year, an actual extract was first used by G. R. Murray in 1891. In 1894 Oliver and Schäfer prepared an active extract from the adrenals, and in the next year one from the pituitary. In 1902 Bayliss and Starling discovered secretin as a stimulant to the secretion of pancreatic juice. Though this last has not found practical application, it excited great interest in the whole subject of the chemical control of the body, and by 1905 Starling, in his Croonian Lectures, already found it possible to put together a general scheme of the hormones, as he then christened them. It was known that thyroid extract could produce glycosuria, and in 1901 Blum showed that the same was true of adrenalin. Herter noted that

direct painting of adrenalin on to the surface of the pancreas would have this effect and thus the idea of antergic endocrines began to take shape. Another event of great importance was Langley's generalization in 1901 that the effect of adrenalin on any part was the same as that of stimulating the sympathetic nerve to that part. As the cells of the adrenal medulla originate from sympathetic ganglion-cells and actually replace the post-ganglionic portion, there was here the most succinct example of a nervous impulse being transformed into a chemical one; of this, recent work has indicated a number of examples. In these ways a conception of the close interaction between the hormones and the sympathetic nervous system has grown up, and this has thrown quite a new light both on psychoneuroses and on what Sir Archibald Garrod has happily termed the vegetative neuroses, such as Graves' disease.

A study of the relationship between the pigments of the body has had a great influence on medicine. In everyday life the fact that iron rusts is a nuisance, but biologically this property constitutes its great value as an oxygen carrier.

The chemistry of hæmoglobin was clearly worked out by Hoppe-Seyler, who was the first to prepare it in crystalline form about 1860, thereby further invading the vitalist's territory. He also provided the best evidence of the relationship between the pigments of the blood and the bile. Suffice it to say that, until there existed methods of estimating the hæmoglobin of the blood, it was obviously impossible to draw the important distinction between anæmias with high and with low colour indices. Moreover, the pathology of coal-gas poisoning, microbic cyanosis and the porphyrinurias rests on this biochemical work. In 1847 Virchow described the hæmatoidin of old blood-clots, and nearly twenty years later its identity with bilirubin was maintained by Hoppe-Seyler and his co-workers. Hence arose the long controversy as to hepatogenous and hæmatogenous jaundice, which towards the end of last century seemed to have been settled in favour of the view expressed by Gamgee, in 1893, that "all cases of jaundice are due to reabsorption of bile, already formed in, and by, the liver." That excessive hæmolysis might be followed by jaundice was admitted, but this was referred to an accompanying catarrh of the bile capillaries. Just when this unity of jaundice seemed fairly established, however, the clinical recognition of acholuric jaundice compelled reconsideration of the whole question. Here it was biochemistry which was indebted to medicine, rather than vice-versa. Nor is this, by any means, the only instance. In 1921, van den Bergh's application of Ehrlich's diazo test to the detection of bile pigments in the blood confirmed the existence of a purely hæmolytic jaundice, and this work forms an integral part of our modern conceptions of jaundice. Closely linked to this question of blood pigments and bile pigments is that of the urinary pigments. Jaffé, in 1868, prepared a pigment from urine to which he gave the name of urobilin; in the following year Maly prepared a reduction product from bilirubin which he called hydrobilirubin and which he believed to be chemically identical with urobilin. About the same time stercobilin was described as a fæcal pigment of a similar character. The chemical relationship between these pigments was the subject of much controversy, and credit must be given to MacMunn for his laborious researches, published between 1880 and 1889, which were carried out in the midst of busy practice in Wolverhampton. But it was not until 1896 to 1900 that the whole subject was reduced to order by Garrod and Hopkins. They showed that the chief urinary pigment was urochrome, as maintained by Thudichum in 1864, but that its origin from hæmoglobin was entirely different from that of urobilin. Hydrobilirubin and stercobilin were both reduction products of bilirubin, closely related but not chemically identical. Urobilin was merely stercobilin that had been reabsorbed from the bowel. If no bile enters the bowel there is no urobilin or the chromogen thereof in the urine. This clarifies the whole position, and is of practical value, because it not only makes it possible to assess the importance of urobilinuria but also gives diagnostic clues in diseases of the bile-passages. Some of the

spinners of elaborate clinical deductions from urinary and fæcal analysis should read, mark and inwardly digest this work. Urobilinuria would then not lead so frequently to the diagnosis of "floating gall-stones" as one finds in French medical literature. The method of duodenal intubation introduced by Einhorn and elaborated by Lyon greatly added to our powers of investigating the diseases of the gall-bladder.

If I had to assess the value of biochemistry in our knowledge of nephritis, I should feel considerable difficulty, for, while it has revealed the inadequacy of the classifications based on morbid anatomy, it has not, up to the present, replaced these by any very clear-cut conceptions. Here destructive criticism has had to precede reconstruction. My task is the simpler one of recording the sequence of certain events. The recent celebration of the centenary of Richard Bright's description in 1827 of the disease associated with his name, sent us back to his original paper and made us realize that he appreciated the pre-renal factors in nephritis but that this had been largely forgotten. Gradually it was recognized that what the kidney failed to excrete was of even greater importance than the things it allowed unduly to escape. A method for the quantitative estimation of urea in the urine was introduced by Ludwig in 1853 and subsequently ones for clinical purposes by Doremus and by Dupré, but for some time the results were misinterpreted because it was not realized that the amount of protein in the diet influenced the amount of urea in the urine. The fact, already alluded to, that food proteins are disintegrated to amino-acids, a large proportion of which are promptly converted by the liver into urea, forced attention to this point.

Obviously, therefore, to obtain a clear idea of renal efficiency it was necessary to compare the urea in the blood and in the urine. As far as I can determine, this was first done by Widal and Javal in 1905. In 1914 Ambard, as the result of experimental work, formulated three laws with regard to renal efficiency in the matter of urea excretion, and based a mathematical coefficient upon them. But I fear this was an example of premature iatro-mathematics. The kidney does not always appear willing to conform to it. The urea-concentration test introduced by Maclean and de Wesselow just after the War was a distinct step in advance, while the recent developments at the hands of Van Slyke have already been mentioned.

The recognition of urea retention in certain cases of nephritis and not in others led to a distinction being drawn between hydræmic and azotæmic nephritis by the French school. But biochemistry to-day is very chary of accepting the idea of a watery dilution of the blood-volume. Rowntree and his co-workers in 1929 showed that in glomerulo-nephritis and in nephrosis the blood-volume was within normal limits, unless there was accompanying anæmia, in which case it was only slightly raised. The introduction of diuresis had no constant effect on blood-volume; evidently the excess of fluid must be drawn from the tissues. This leads us back to the history of the biochemistry of lymph-formation and the pathology of œdema.

Ludwig in 1844 put forward a physical conception of urinary secretion; he regarded the pressure of the blood as its direct excitant; for him the glomerular epithelium was a passive filter while reabsorption occurred in the tubules. Heidenhain in 1866 strongly opposed this view regarding glomerular activity as a true secretion. His work caused Ludwig to modify his own theory, when in 1870 the latter discovered that urea had a diuretic effect even after the blood-pressure had been lowered by section of the spinal cord. He therefore came to regard glomerular activity as due to osmosis through a semipermeable membrane. These protagonists were also engaged in a similar controversy over the allied subject of lymph-formation. Ludwig in 1850 explained lymph-formation by diffusion, the motive power being the capillary blood-pressure. In 1880 Heidenhain, having observed a friend afflicted by urticaria after eating some crab, was struck with the idea of certain stimulants to lymph-formation which he termed lymphogogues. He described two classes of lymphogogues, one organic, such as

extract of crab-muscle, and the other crystalloid substances. He opposed Ludwig's physical views and set up a secretory hypothesis of lymph-formation. Langley, who had worked under Heidenhain, returned to Cambridge impressed with the merits of this secretory view. Then Starling, who had also worked with Heidenhain, reverted to a more mechanical theory in his Arris and Gale Lecture in 1896. The first class of Heidenhain's lymphogogues he explained as being merely toxic to the capillary endothelium while the second acted by osmosis. His criticisms were certainly very destructive to Heidenhain's position, and from that moment the tide turned against secretory theories for lymph-formation and for glomerular activity. The late Professor Cushny strongly upheld the theory of reabsorption by the renal tubules; he jokingly said that, when he published his work in 1917, he did not expect he would have a friend left. As a matter of fact, his book commanded general acceptance; there was no doubt that Heidenhain had already lost the day. But Ludwig's conception was not inclusive enough to explain œdema satisfactorily, and researches were made in other directions. Widal's theory of salt retention in the tissues was advanced in 1903, but recent work as put forward in Izod Bennett's Goulstonian Lectures for 1928 interprets salt retention as the result and not the cause of œdema. Epstein in papers published in 1912 and 1920 suggested two other possible factors; a high grade of albuminuria depleting the plasma of proteins would lower colloid osmotic pressure while excess of cholesterol in the blood appeared also to be associated with œdema. But there is no constant relation between the reduction of osmotic pressure in the blood and the degree of œdema, while though hypercholesterinæmia occurs with œdema, it is, as Maxwell showed, more of prognostic value than in causal relationship. And so, as previously hinted, the most usually accepted explanation of renal dropsy to-day is an alteration of the affinity of the tissue cells for water as the result of an altered metabolism. In respect of the tissue change, the view expressed by Martin Fischer in 1910 is accepted, but not his interpretation that this change is due to an acidosis.

Here I must leave nephritis, nor shall I attempt to deal with the chemistry of other nitrogenous bodies such as the purins, beyond recalling the classical observations of Sir Alfred Garrod on uric acid in blood.

Although examination of excretions and secretions had been practised for so long, it was not until the very beginning of this century that Quincke put into our hands an entirely new diagnostic procedure, by his introduction of lumbar puncture. Though at first examination of the cerebrospinal fluid was confined to such things as its pressure, its cell content and its bacteriology, later on the chemical features, such as the amount of protein, sugar, salt and the presence of globulin and of altered blood, have not only proved of diagnostic value, but have given information as to the interchanges between the blood and the tissue-fluids. The biochemical examination of pleural and of ascitic fluids has also given clear ideas of the difference between exudates and transudates.

Haldane and Priestley's paper in 1905 on the composition of alveolar air inaugurated a new outlook on the biochemistry of respiration, for carbon dioxide was then recognized as the great stimulus to the respiratory centre. The apnœa following over-ventilation, which Head had referred to purely vagal causes, was now seen to be due to washing out of carbon dioxide from the alveolar air. Mere forced breathing for a couple of minutes was found to produce such apnœa that the subject of this experiment on himself would acquire an alarming lividity and develop tetany before he had the slightest inclination to breathe again. The body's tolerance of temporary oxygen lack was found to be much greater than had been realized. This led to the recognition of the influence of increased hydrogen-ion concentration in the blood in the production of dyspnœa and clarified ideas of anoxæmia in general.

It may fairly be claimed that the introduction of biochemical methods has

contributed to a scientific explanation of the old adage that "one man's meat is another man's poison," by helping our understanding of idiosyncrasy, which Jonathan Hutchinson called "individuality run mad," and which Rolleston has defined as an abnormal reaction in an otherwise normal person. The idea of anaphylaxis was introduced by Richet in 1900 as the antithesis to prophylaxis. In 1906 von Pirquet introduced the term allergy to include all conditions of altered reactivity. A more precise chemical connotation was given to the subject by Sir Henry Dale's researches on histamine in 1910, followed by Sir Thomas Lewis' observations on the vascular reactions in the skin. A substance toxic to everyone is apparently only liberated in the tissue of certain people in answer to stimuli which are innocuous to everyone else.

Thus we were led to an extraordinarily interesting position and one which I should regard as the actual growing point of knowledge; I mean the relationship between the chemical and nervous factors in the reaction of the organism to disease. For Lewis showed that for one of the reactions he observed the afferent nerve fibres must be intact while another was independent of the nerve supply. Meanwhile, Dale made two important observations bearing on this question, one that adrenalin directly antagonizes histamine, the other confirming Dixon's demonstration that the effects of vagal or of sympathetic stimulation on the heart are indirect, being mediated through the liberation of chemical substances which are inhibitory or accelerating in action. Adrenalin is the best antidote to an allergic crisis because it both neutralizes histamine and stimulates the sympathetic nerves, which are inhibitory to certain "plain" muscles such as those in the bronchi. And as already stated the effect of adrenalin on any part is the same as stimulation of the sympathetic nerves to that part. Here are clear instances of the transformation of a nervous into a chemical action, and the pituitary-diencephalic apparatus provides us with others. It is a familiar observation that the psychic state can modify the chemical manifestations of allergy, and the emotions are mediated through the diencephalon. This indicates the complexity of clinical problems, which biochemistry by itself is inadequate to solve.

Section of Laryngology.

President—Mr. WALTER HOWARTH, F.R.C.S.

[*March* 4, 1932.]

Exophthalmic Goitre. Diathermy Removal of Tonsils. General Symptoms Improved.—DAN MCKENZIE.

This patient came before the Section about eighteen months ago. The improvement noted then has been maintained and developed. Along with the typical signs and symptoms of exophthalmic goitre of a moderate severity, the tonsils were large and subject to frequent tonsillitis. Their removal under local anæsthesia took a long time, by reason of the cardiac irritability. At present the patient is, as near as possible, a healthy woman. She has put on weight, has lost her nervousness, and is capable of a good day's work or play. The goitre is only just visible; the pulse-rate is much lower than it was, and the relief has now lasted for over a year. The removal of the tonsils was completed without the loss of a day's work.

Sinusitis with Orbital Swelling Treated by Antral Lavage.—T. B. LAYTON.

Female, aged 15. Admitted to hospital October 10, 1931, with œdema of both eyelids and forehead. Treated medically for some days, then right antrum washed out: pus. Left antrum: pus escaped from cannula but would not wash through. Owing to blockage of left antral orifice, high resection of middle turbinal performed to drain frontal and ethmoidal region. Discharged November 17, 1931. Œdema much diminished, but fluctuating swelling still present. December 28, 1931: Sinuses clear after four washings.

Patient, aged 11. Orbital swelling and pus in nose after scarlet fever. Pus in left antrum. Discharged from hospital and treated by weekly washings and puncture of swelling under novocain. Two further weekly washings. Recovery.

V. NEGUS said these cases showed the value of antral lavage. Operative measures in acute cases frequently ended disastrously, and intracranial complications followed the operation. Practically every case of acute frontal sinusitis could be cured by washing out the antrum, combined with something which would cause shrinkage of the middle turbinal. He used protargol, with small packs inside the nose. This, carried out twice a day, with daily lavage would cure most cases of acute frontal sinusitis. If pus had broken through the sinus and had produced an abscess it must be drained externally, but many cases of swelling of the forehead recovered in a short time.

Intrinsic Carcinoma of Larynx: Laryngofissure: (?) Recurrence.—R. SCOTT STEVENSON.

Male, aged 68. Biopsy of vocal cord showed carcinoma (epithelioma). Laryngofissure November, 1931. Right vocal cord removed. Growth did not involve either commissure. There is now dyspnœa. Is this due to a recurrence?

Discussion.—HERBERT TILLEY said the appearances suggested a cyst, with a smooth pale surface. Until twelve months ago he would not have thought it possible that a cyst could occur in the larynx in the situation from which a malignant cord had been removed, but last spring a patient, whose malignant cord he had removed in 1927, complained of severe stridor. By the direct method he punctured the cyst with the galvano-cautery, and removed the walls with forceps; the patient went home two days afterwards.

SCOTT STEVENSON (in reply) said there was a rounded swelling on the right side, and he suspected a recurrence. There were no enlarged glands. He had wondered whether removal of the thyroid ala was really necessary. He thought that perhaps the lateral wall had fallen in because the thyroid ala had been removed.

Frontal Sinusitis; Orbital Cellulitis; Insular Panostitis three inches away; Recovery.—E. A. PETERS.

Man, aged 24 in May, 1927, admitted to hospital on account of œdema of the left orbital and frontal regions. No pus seen in the nose. Skiagram showed that left frontal sinus was involved. Moure's incision. Lower wall of frontal sinus removed. Middle turbinal removed, agger cell opened and intranasal drainage of the sinus carried out. Three days later swelling of frontal sinus extended to the other side, so a transverse incision was carried out and the right frontal sinus drained intranasally. Three weeks later a small patch of cellulitis appeared near the coronal suture and in six months' time a sequestrum of dead bone a quarter of an inch in diameter was removed; it involved the whole thickness of the calvarium.

Recurrent Papilloma of the Larynx.—E. A. PETERS.

A woman aged 24 complained of hoarseness for 18 months previous to operation. In December, 1930, a papilloma was removed and again in June, 1931. The papillomatous growths have extended and now cover the circumference of the glottis. The patient complains of loss of voice. The chest has been radiographed, and no trace of tubercle found. Suggestions for treatment are invited. A section of papilloma removed is shown.

Discussion.—HAROLD BARWELL said that multiple papillomata were rare in adults, and the only treatment appeared to be to persist in removing them as they recurred, until they ceased growing.

HERBERT TILLEY agreed with removal of these papillomata, but recommended drying of their bases as far as possible, and then applying monochloracetic acid. It had a more penetrating action than the cautery or than silver nitrate, and there was less likelihood of recurrence, although freedom from recurrence could not be guaranteed.

A. J. WRIGHT said he wished to correct the idea that after a time these papillomata ceased to recur; he had under care a lady aged nearly 80, on whom Sir Henry Butlin had operated by thyro-fissure for papillomata when she was 30; the late Dr. William Hill had also operated upon her several times, and the growths were still recurring. There had never been any signs of malignancy.

E. BROUGHTON BARNES said that papillomata should be removed through a tube, and he recommended, instead of chemical treatment of the stump, cocainizing the larynx thoroughly and treating the stump with diathermy. The smaller papillomata could be destroyed by diathermy without using forceps.

T. B. JOBSON said he had treated a child aged 8, with diathermy for papilloma of the larynx. He used a flat electrode on the cord, and just turned the current on and off again. The child did well, and the voice, which had been discordant, improved very much. There was neither dyspnœa nor call for tracheotomy afterwards.

DISCUSSION ON THE TREATMENT OF THE SUPPURATING MAXILLARY ANTRUM.

W. M. Mollison: The suppurating antrum does not necessarily contain laudable pus; the contents are often mucopus or more like mucus than mucopus; in the so-called hyperplastic inflammation of the antrum there may be no secretion at all. No doubt it is the uncertainty as to the contents of the antrum that leads some to advocate radical operative treatment in all cases.

Acute suppuration.—There must be numberless cases of suppuration that recover spontaneously; the common cold is often complicated by sinus pain relieved suddenly by discharge from the nose.

It should be the object of the rhinologist to assist nature to this spontaneous cure. To that end, sprays of weak adrenalin, 1/3000, should be used every three hours, or ephedrine, and heat to the head by means of the special "bath" heated with electric lamps.

Should recovery not follow, puncture through the inferior meatus is carried out. In acute cases, local anæsthesia is not always satisfactory, and I have found that sensitive patients, at least, appreciate gas and oxygen anæsthesia.

The fluid in the antrum may be clear yellow and escape under considerable tension; as a rule it is pus, and must be withdrawn by means of a syringe or washed out with saline. One such washing is frequently enough to bring about recovery.

In some cases which refused to clear up after the usual puncture and washing, a good result has been obtained by giving the patient sodium bicarbonate to render the urine alkaline and by using a solution of bicarbonate for washing out the sinus.

In cases in which attacks of acute inflammation recur with every infection, it is well to remove the anterior end of the middle turbinal.

Chronic suppuration.—Chronic antral suppuration is taken to include all cases other than acute, though this may not be strictly accurate.

It has been shown that the washings from an antrum may be macroscopically clear but may contain organisms; threads of mucus only may be seen as evidence of disease in the antral wall.

Prophylaxis.—It has been shown that a diet deficient in vitamin A predisposes to upper respiratory tract infections; on the other hand, a really correct diet, properly balanced, prevents such infections. Thirty new-born infants were placed in a ward and kept there for two years, under ideal hygienic conditions; no infections of the upper respiratory tract occurred, except in the case of one child whose mother withheld cream in error.

One observer suggests that there are three factors that lay the mucous membranes open to infection: (1) deficiency in vitamins; (2) allergy; (3) endocrine imbalance. If these factors can be corrected in some way, infections might be avoided.

That a change in the reaction of the mucous membranes is important is suggested by an observation on the action of radium. A series of cases of chronic sinusitis on which operations had been performed without success were treated by exposure to radium: much improvement was noticed.

How does the antrum empty itself?—It is logical to investigate this question, as a preliminary to discussing treatment of antral suppuration. The most important factor is ciliary action; when acute infections occur the cilia are temporarily put out of action.

Another factor has been suggested, namely, the alternating negative and positive pressure in the sinus during respiration. To determine the amount of this positive or negative pressure, a small water manometer was used. This was attached to a hollow needle introduced into the antrum in the ordinary way, under the inferior turbinal. Patients with normal noses showed during quiet inspiration a negative pressure of 2 to 8 mm., during expiration a positive pressure of 4 mm. Forced respiration

increased these figures. It is obvious that if there is (*a*) an accessory opening, or (*b*) a second opening produced surgically, the negative pressure will be lessened and drainage hindered.

The antra of a normal person were injected with iodized poppy-seed oil through the canine fossæ. One side of the nose was then blocked with wool and sealed with collodion. The patient was kept in the vertical position for seventeen hours. At the end of this time he removed the plug and refused further co-operation. X-ray examinations made at intervals throughout the experiment showed that the iodized oil spread upwards along the nasal wall of the normal side antrum and fell into the floor of the nose and in seven hours the antrum was nearly empty, while on the obstructed side no movement of the oil was seen after the seventeen hours. It would be interesting to repeat this experiment in a patient with congenital atresia of one side of the nose.

Surgical treatment.—(1) Intranasal operation.—Consists in making a hole into the antrum below the inferior turbinal, combined, in most cases, with removal of the anterior end of the middle turbinal. Except in special cases this is the operation of choice. When the hole in the antral wall is made sufficiently large it remains open enough to pass a canula; it must be made large in the first place, as it shrinks rapidly. Actually I am not convinced that a permanently large hole is advisable; a better result is often seen with a small than a large one. At the end of the operation itself, I pack in a strip of ribbon gauze, moistened with 10% argyrol, partly to introduce the argyrol, and partly to make sure that all discharge is removed; the strip is then removed.

Antral suppuration in children should always be dealt with by the intranasal operation and the removal of adenoids, if any. I believe that antral suppuration in children is more frequent than formerly.

It will be noticed that no mention is made of removal of part of the inferior turbinal. I feel strongly on this point; in my opinion, the turbinal should not be touched. The opening into the antrum can easily be made under it; if the turbinal is much in-curled, it can be levered away from the outer wall. Some of the most intractable cases of post-operative discomfort from crusting are those in which large parts of the inferior turbinal have been removed and a very large hole made into the antrum.

(2) Per-oral operation.—In certain cases an intranasal operation is inadequate and the so-called radical operation is required. These are cases in which (1) the intranasal operation has failed: (2) the contents of the antrum are cholesteatomatous. (3) there are foreign bodies in the antrum, including teeth, or bits of teeth; (4) there are antro-choanal polypi that recur after simple removal, and cases of polypoid lining; (5) there are fistulæ.

Canfield's operation I find difficult, and probably for that reason alone I do not see its advantage over the others.

In the Caldwell-Luc operation the incision is generally made horizontally, but a vertical one can be used. In order to prevent damage to the nerves going to the teeth, the bone area removed should be triangular, with the apex downwards. In spite of this, the nerves to the incisors may be damaged. Retraction of the tissues upwards must not be violent, to avoid damage to the infra-orbital nerve. Neuralgia of the second division of the fifth nerve due to too violent retraction is sometimes seen after the Caldwell-Luc operation, and is most intractable. I speak feelingly, having had two cases.

Removal of the naso-antral wall is to be made low down and without damage to the mucous membrane of the inferior meatus. It is the custom to make a large flap of this mucous membrane and turn it down into the floor of the cavity, and I have found this satisfactory. Actually it has been suggested that the mucous membrane should be left, a small hole being made later if necessary.

The lining of the antrum remains to be dealt with. Ciliated epithelium regenerates well in any part of the body, and the antrum is no exception. Recently work has been done on this subject in Toronto; even after removal of the antral lining, epithelium reformed; thus regeneration has been noted sixteen days after operation at which all the lining had apparently been removed; ciliated epithelium has been found in the dog one month after removal, and in man nine weeks after. The epithelium arises either from microscopic lining left after operation or it grows in from the nose. Evidently the more islands of epithelium that can be left the better: for this reason it would appear important not to scrape away the antral lining too vigorously, better probably only to nip off the exuberant polypoid lining.

Lastly there are cases of antral disease that continue to suppurate in spite of well performed Caldwell-Luc operations; the discharge is very annoying to the patient and may continue for years. Re-opening the antrum and skin grafting the cavity will sometimes give a good result.

A. J. M. Wright: *Acute suppuration.*—Most of us now regard the washing of an acutely inflamed mucous membrane as undesirable. In cases without complicating factors, such as the involvement of other sinuses, an acute suppuration almost invariably clears up without puncture and lavage, and I find myself puncturing the acute suppurating antrum less and less frequently.

Chronic suppuration.—In cases of chronic antral suppuration, it is of importance to adapt methods to the pathological conditions present rather than to follow a stereotyped treatment.

The types of suppuration are: dental, nasal, polypoid, and a mixed group described as mucoid, œdematous or allergic. In this last group I include cases in which frank suppuration is absent, but in which there is a mucoid discharge, œdema of the mucosa, and perhaps an allergic factor. While the title of this discussion would seem to exclude such cases, I find myself unable to do so.

Dental suppuration.—In cases of recent origin, in which the infecting tooth is obvious, it is worth while to remove the tooth and then to wait before carrying out any operation on the antrum. In a few such cases, the suppuration clears up spontaneously, but should it not do so, it is better to postpone operative drainage until the alveolus has healed. A simple intranasal operation in dental cases is usually satisfactory. If suppuration persists after operation, it is probably due to infection of other sinuses, the presence of unrecognized infection in other teeth, the existence of a syphilitic or malignant element, infection in the bone, or the removal of too much of the inferior turbinal. In cases of bone infection only time will cure.

Nasal suppuration.—In cases in which the antrum alone is involved, an intranasal operation is all that is required.

Polypoid cases.—Cases with polypoid degeneration of the antral lining are usually due to a nasal infection and accompanied by suppuration in the ethmoidal and sometimes the frontal sinuses. This polypoid degeneration seriously alters the prognosis. A simple intranasal operation is usually followed by the extrusion of polypi through the operation opening into the nose. I have been in the habit of opening the antrum through the canine fossa and removing the polypi thoroughly, but recurrence has been frequent. The researches of Knowlton and McGregor show that it is possible for the lining to be replaced after its complete removal. I think that this treatment is worthy of further trial in such cases.

Œdematous or Allergic Cases.—By this I mean cases in which, on exploratory puncture, the antrum is found to contain mucus or in which puncture is negative but X-ray examination shows changes in the antral mucosa. Although I am aware that extensive operative interference on the antrum has been advised by some observers in cases in which frank suppuration is absent, I believe that the more

rational line to follow is the use of constitutional measures, combined with the operative treatment of any mechanical factors which may be interfering with nasal drainage and ventilation.

Dan McKenzie said that nothing had proved so beneficial to the patient and so creditable to the laryngologist as puncturing an acute suppurating antrum. He wished as much could be said of the operations for the chronic suppurating antrum. On previous occasions he had referred to the uneasiness with which he contemplated operating in many cases of chronic suppuration of the maxillary antrum and other sinuses. It seemed to him that something essential about the pathology of sinus suppuration was not understood. In spite of a perfectly planned and executed operation, a large percentage of the cases continued to suppurate. It was all very well to say that the reason was because other sinuses were suppurating, but frequently this could not be detected, and even if they were, operation on other sinuses did not help. He did not think it was a question of vitamins, for the mass of our people were not deprived of these bodies. Attention ought to be bestowed upon finding the unknown factor which kept the suppuration going whatever the surgeon might do.

A. Logan Turner: The various statistical tables published from time to time clearly show that the incidence of complications from this cavity is much lower than that of complications from the other paranasal air cavities. In Burger's Table on which 534 cases of intracranial complication are tabulated, only 18, or 3% of the whole, had the primary focus in the maxillary cavity. This is not surprising if we recall the fact that this sinus is the only one of the series that has no bony wall contiguous to the cerebral cavity. Consequently, infection of the brain and its membranes by direct continuity of inflammation through the bone—a frequent pathway of intracranial infection—is excluded in the case of the maxillary cavity.

Infection of the intracranial structures, however, by the venous pathway is a possible route, as the veins of the lining membrane of the antrum link up with the pterygoid venous plexus and through it with the cavernous blood sinuses. In this connection it is interesting to note that of the 18 cases referred to on Burger's table, in more than half, the complications were of the nature of a thrombo-phlebitis of the dural blood sinuses.

I should like to refer to the complications consecutive to operative trauma of the maxillary air cavity. These unfortunate occurrences take place from time to time, perhaps more often than we realize. An inquiry some years ago, from laryngologists in this country, into the incidence of complications in paranasal sinus suppuration brought me this information, that of 60 cases returned, in which the complication supervened on operation, 14, or 23%, arose in connection with operations on the maxillary sinus, six intranasal and eight of the Caldwell-Luc type.

In these, diffuse osteomyelitis of the maxilla occurred as the initial stage in 13. Showing itself some days after operation as a swelling of the cheek, osteomyelitis then invades the frontal process and extends to the nasal and frontal bones, and, unless checked in the early stage, results in fatal complications. Of the 13 patients with diffuse osteomyelitis, seven died from leptomeningitis, four died from general blood infection, and two recovered, the osteomyelitic process being checked by timely surgical interference on the maxilla.

Some years ago Mr. Tilley suggested that in these cases the diffuse osteomyelitis arose because of associated suppuration in one or more of the higher cavities, a cancellous area in the bony margin of the surgical opening within the nose becoming infected and the inflammation spreading through the body of the bone.

I have investigated in these 13 cases the question of associated suppuration in the higher sinuses and I found from the notes supplied that in 10 of them this

existed; that in six of these there was no simultaneous treatment of the higher sinuses, and in four there was, but in two of the latter there was only intranasal drainage carried out. These facts, therefore, tend to support Mr. Tilley's view, and they do more than that; they furnish evidence of the possible risk to which our patients are exposed in the operative surgery of paranasal sinus suppuration through our failure to remove at one and the same operation all the foci of infection.

T. B. Layton: Accepting antral lavage as the routine treatment of all cases of suppuration in the maxillary sinus other than those in the acute stage, we may consider (*a*) the intervals between the washings, (*b*) the number of the washings to be employed before resorting to a major operation, (*c*) the condition of the patient, (*d*) the character of the pus, (*e*) indications for immediate major operation.

(*a*) From four days to a week is the convenient interval between washings. Under four days the meatus may became so tender that the later washings are unduly painful; over a week the treatment tends to become too prolonged if the lavage proves unsuccessful.

(*b*) I used always to wash out the sinus four times before considering further operation; after a talk with Sir StClair Thomson I extended these to six, but I do not remember in the last three years any case in which the extra two have obviated the major operation. Certainly a large number of washings will sometimes result in cure, and I have heard of one that recovered after the thirty-eighth lavage. If for social or other reasons a major operation is inconvenient, it is quite proper to go on washing out the antrum at weekly intervals for this long period and an occasional cure will result. In many cases less than four washings are sufficient. In a recent case, when the acute stage has not been severe, one lavage is often enough, and on the second occasion the fluid is clear.

(*c*) It is remarkable how the general condition of the patient will improve after the first or second lavage. So striking is this that the condition of the patient is never an indication for resorting at once to a major operation. Rather it is the opposite, as the toxæmia can be improved by the lavage before this is done. For this reason a severe toxæmia forms in my opinion the only indication for performing even the operation of antral lavage in the acute stage. The great improvement in the toxæmia outweighs the risk of acute osteomyelitis arising therefrom.

(*d*) I used to think that very foul-smelling pus was a sign that the condition would not clear up by lavage. I used to think the same when there was no diminution of the amount after the second or third lavage. The following case shows that both these assumptions are unfounded.

A patient came from the Channel Islands and, hating London, wanted to return as soon as possible after operation. On the possibility of being cured by lavage being explained to him he elected to risk the extra time here in the event of failure. The pus was very foul-smelling and very profuse. At the third lavage it was as bad as with the first, and I told him I thought he was wasting time to have a fourth and that we had better proceed at once to the major operation. He replied that having set out on a certain plan we would stick to it. Four days later at the fourth lavage the washings were clear. He came to see me on visits to London on several occasions in the subsequent three years and remained well.

(*e*) If a piece of fang or a tooth has slipped into the antrum during an attempt at extraction, no treatment will ever cure the condition unless it includes the removal of that foreign body from the cavity. Except for this there is no indication for a major operation, whether intranasal or by the sublabial route, before trial of lavage. Certain considerations may however lead one to decide on one of these after the fourth washing without further delay.

(i) Sometimes the opening of the antrum is occluded by the swollen mucosa. When this is the case, the slightest pressure causes the most intense discomfort, with exquisite pain leading to fainting and symptoms of shock. Formerly I have operated on such cases

immediately. A case which I have exhibited to-day shows that this is unnecessary, and the device of a two-way canula should obviate the necessity for it in the future.

(ii) On social grounds the operation may have to be hastened. An Anglo-Indian returning to an outlying station where treatment would have been unavailable in the event of recurrence, and a schoolmistress who had to complete the treatment within the Christmas holidays are examples of this. Another is pregnancy; a mother is able to afford time for operation while carrying her child, but cannot do so once it is born.

(iii) The involvement of other sinuses is another reason for not continuing with lavage too long. The diversion of the stream of antral pus from the middle to the inferior meatus affords a better opportunity for the fronto-ethmoidal cells to recover than is afforded by any operative treatment in the middle meatus.

That a major operation is not essential under the conditions is proved by the two cases I have shown to-day.

The success of antral lavage is the chief reason why I seldom perform an intranasal operation on the maxillary sinus. I believe that the majority of cases in which success is claimed for this operation are ones which would have recovered with the simpler treatment of antral lavage. Of the unsatisfactory nature of this operation one hears from anæsthetists and general practitioners, rather than from rhinologists. The failure is due to the ease with which the hole may close when edge is opposite edge. With the sublabial operation it is possible to make Hajek's flap from the mucous membrane of the inferior meatus, with the result that cut edge opposes a surface and the opening cannot close. Further, the intranasal operation can rarely be carried out without removal of a part of the inferior turbinal which I think is a wrong proceeding.

H. Bell Tawse: There are two points in the treatment of chronic suppuration to which I wish to refer:—

(1) I remove a small piece of the anterior end of the inferior turbinal in the intranasal operation, on every occasion, unless there is so much room under the inferior turbinal that a large hole is ensured.

Where the anterior end has been preserved, I have had so much trouble with the hole contracting and closing up before the cavity has healed that I hesitate to rely on it. I find it difficult to understand why the anterior end is treated with such great respect by some, and I should like to ask why more respect is not shown for the anterior end of the middle turbinal. I have rarely been troubled with crusting after a small piece of the anterior end has been removed, but I cannot say that the same applies to the middle turbinal.

I do not wish you to think that I advocate the use of the spokeshave or that I approve of this ruthless and barbaric treatment of the inferior turbinal. But I am at a loss to understand why the removal of a small piece of the inferior turbinal should be followed by crusting in the hands of some and not of others.

(2) I seldom employ the Caldwell-Luc operation as the great majority of cases can be cured by the intranasal one.

I disagree with the textbook statement "that until evidence is forthcoming which will furnish reliable information, the canine fossa route is to be preferred to the nasal." This operation should be reserved for cases in which the mucous membrane is known or strongly suspected to be polypoid, either from skiagrams or from the limited inspection that is possible through an intranasal opening, or where malignant disease has to be confirmed.

In my early days I always employed the Caldwell-Luc operation. Then I began to ask myself, "What additional benefit have I conferred on the patient by opening the canine fossa?" and in the great majority of cases the answer was "None." Again, although one inspected the lining of the cavity, it was almost invariably left

untouched and one had frequently to enlarge the opening to facilitate removal of the inner wall. Not infrequently the patient had a swollen, painful cheek for at least a week, toothache was not uncommon, the wearing of a denture was occasionally impossible for some days, and infra-orbital neuralgia was not unknown.

I believe that efficient drainage by the intranasal operation followed, preferably, by lavage with normal saline solution, should replace the Caldwell-Luc operation in every case except those in which gross lesions are present, indicating that drainage alone will not suffice.

C. A. Scott Ridout said that the guiding rule in every acute condition should be to do as little as possible, but any pent-up pus, particularly if it was under pressure, must be evacuated. In the early stages of an acute maxillary sinus case, 2% cocaine was more useful than the spray which Mr. Mollison had suggested.

He agreed that it was important to preserve the inferior turbinal, for if that was removed there would ensue crusting of the nose and constant irritation. That should be avoided in doing intranasal antrotomy. If closure occurred it could be repeated; but one could not replace the removed turbinal.

Suppuration in this region was becoming more frequent in children, and he did not agree that in suppuration of the antrum the removal of adenoids alone was sufficient.

Lavage should be carried out if pus was seen in the nose at the operation for adenoids.

In cases of naso-antral polypi he did not hesitate to perform the Caldwell-Luc operation. Or if there was constant suppuration with a thickened mucosa he saw no method of dealing with it except by that—or a Denker's—operation. In some of the cases of chronic rhinorrhœa in which the antrum could not be traced as a cause, a useful method was radiography with lipiodol; one had the patient in the erect posture, and as the antrum filled with lipiodol, the skiagram was taken immediately. Any irregularity in the mucosa would show in the picture.

The Operative Closure of Oro-Maxillary Fistulæ.

By Douglas Guthrie.

Ætiology.—The inadvertent removal of part of the floor of the sinus during extraction of the upper molar tooth is perhaps the most frequent cause. Naturally the accident is more likely to occur when there is little or no bone between the roots of the teeth and the floor of the maxillary sinus. As a rule the opening soon closes, but if the sinus becomes infected the fistula may persist, even after free intranasal drainage has been provided. Less frequently, oro-maxillary fistula may follow radical operation of the sinus, or on a dental cyst which involves the sinus. Hempstead [1] saw 63 persistent fistulæ in 385 cases of chronic maxillary sinusitis, but there is no doubt that fistula following operation on the sinus, has become rarer as operative technique has improved, and as alveolar drainage has been abandoned.

Historical note.—In 1651, Nathaniel Highmore [2], whose name is associated with the antrum, described, in the elaborate language of his day, a case of oro-maxillary fistula. In his work on human anatomy, dedicated to his friend Harvey, he tells how "a gentlewoman, who had the Dens Caninus drawn on account of an inveterate defluction of sharp humours, on thrusting a silver bodkin into the alveolus, was exceedingly frighted to find it pass, as it did, almost to her eyes."

Some years later William Cowper, an anatomist of great distinction, acknowledged that Highmore's case had suggested to him the operation of alveolar drainage of the sinus, which he described in Drake's "Anatomy" [3].

Treatment.—(*a*) *Conservative treatment* is of little value, and the wearing of a dental plate with obturator to occlude the fistula is uncomfortable and inefficient. Weih [4] reports six cases successfully treated by repeated applications of trichlor-acetic acid,

and Drury [5] claims to have cured seven cases by daily application of liquor epispasticus. Curettage only makes the fistula larger.

(*b*) *Treatment by a plastic operation.*—When the opening is small and limited to the alveolus, Zange's operation [6] may suffice. This consists in separating the epithelial lining of the fistula, tucking it into the opening as is done with the stump of an appendix, and then covering the raw area with alveolar and palatal flaps, like sliding doors. For larger openings similarly placed, a wide flap of muco-periosteum from the palate may be secured by making a median incision, Welty's [7] method, or by extending the palatal flap, Dunning's [8] operation.

When the opening is in the canine fossa, the problem of closure is more difficult. Claoué [9] makes use of a U-shaped flap of mucosa, which is slid down from above the fistula. Frenzel [10] uses a large flap, swung across from the inner surface of the cheek, and Fleischmann [11], after excising the scar and fistula, closes the raw area by a bridge-flap attached at either end.

Perhaps the best operation is that described by Axhausen [12] and it is applicable whether the fistula involves the canine fossa, or involves the alveolus. A flap of mucous membrane is taken from the fornix, and it must be cut so deep as to include a thin layer of buccinator muscle. After excising the fistula or inverting its lining mucosa, the flap is stitched over the raw area. Twenty-six cases were treated in this way, 25 of them successfully.

The writer has applied the Axhausen method successfully in three cases during the past year. In an earlier case, not having studied the literature, he closed the opening by a flap, lined on one side with skin, and on the other by mucous membrane. The skin graft, on a lozenge of stent, was implanted in a pocket close to the fistula, and a week later the sides of the pocket were incised, the stent removed, and the flap sutured over the opening. The small area of skin covering the fistula was still readily recognizable six months after the operation, and functionally the result was perfect.

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Section of Tropical Diseases and Parasitology.

President.—Dr. J. Gordon Thomson.

Meeting held on February 4, 1932, at the London School of Hygiene and Tropical Medicine, London, W.C. 1.

DEMONSTRATIONS.

The Gramophone Audiometer.—G. P. Crowden, L.R.C.P., M.R.C.S.

This audiometer was developed by the Bell Telephone Research Laboratories for detecting early signs of deafness in school children. The tests on some 5,000 elementary school children aged from 8 to 15, in the London area, had shown that 65 per thousand suffered from deafness in one or both ears and needed careful otological examination and treatment. This number was very much greater than the number of children detected in the course of routine medical examinations which only revealed 4·2 per thousand in 1928, and 3·9 per thousand in 1930.

The audiometer, with the standard record of spoken numbers, is a much more delicate and accurate test of hearing than the watch tick, whisper or voice. The gramophone can operate forty headphones so that forty children can be tested at one time in a school room, and a school of 400 can easily be examined in a day.

High Temperature Kata Thermometer and Moll Radiation Thermopile.—M. Hetherington, B.Sc.

The Kata thermometer was devised by Professor Sir Leonard Hill for use in the Tropics. Miss Hetherington also demonstrated the Moll Radiation thermopile as a means of showing that an aluminium painted surface radiates from 20% to 30% less heat than a black or red surface. Colonel Stammers had suggested that the inside of topees should be painted with this aluminium paint and the Moll thermopile and galvano-meter clearly showed such a measure to be worthy of trial.

The Blood-sucking *Rhodnius prolixus*.—H. S. Leeson.

Living examples of the blood-sucking bug *Rhodnius prolixus* Stal. were exhibited in order to demonstrate its appearance at all stages of its life history from egg to adult. Its habits, longevity, distribution and connection with Chagas' disease were described.

Some of the Fungi which cause Mycetoma.—J. T. Duncan.

Demonstration of tissue sections of different types of mycetoma with macroscopic and microscopic cultures of the following fungi—*Actinomyces maduræ*, Vincent; *Actinomyces Pelletieri*, Laveran; *Actinomyces somaliensis*, Brumpt; *Actinomyces asteroides*, Eppinger; *Madurella mycetomi*, Laveran (with sclerotial form and saltation); *Scedosporium apiospermum*, Saccardo and *Torula Jeanselmei* Langeron.

The Effect of *Treponema duttoni* on *Trypanosoma rhodesiense* in Mice.—The President showed a chart and stained blood-films illustrating the effect of *Treponema duttoni* on a virulent strain of *Trypanosoma rhodesiense* in mice. The spirochætal infection has a marked retarding influence on the multiplication of the trypanosomes and the lives of the animals are prolonged. Mice inoculated with *Trypanosoma rhodesiense* alone lived about six days but when inoculated simultaneously with *Trypanosoma duttoni* and *Trypanosoma rhodesiense*, many of the animals

survived for three or four weeks. Mice recover spontaneously from a spirochætal infection in about three weeks and the trypanosomes then multiply rapidly and kill the animals.

Dr. H. B. G. NEWHAM exhibited the following:—

(1) A piece of the tree under which Stanley and Livingstone met at Ujiji in 1871.

(2) A petrified bird's nest.

(3) A Chinese physician's compendium of drugs, and ivory figure for diagnosis.

(4) Specimens illustrating the evolution of the dental forceps from early times.

(5) A portrait of Father Damien.

The Effect of Oil on the Tracheal System of the Mosquito Larva.—V. B. WIGGLESWORTH.

This exhibit was designed to illustrate two points: (i) That when a mosquito larva is exposed to oil, this penetrates thoughout the tracheal system and may displace the air completely even in the fines tbranches; and (ii) that only those oils which have toxic constituents are effective as larvicides; for while larvæ are rapidly killed by kerosene, they remain alive and may pupate beneath a film of olive oil.

Ditrichomonas ovis, **nov. sp.**—ANDREW ROBERTSON, M.B.

Dr. A. Robertson showed a series of microscopic preparations of *Ditrichomonas ovis* nov. sp., isolated in culture from the gut of a sheep. Actively motile forms were exhibited under direct and dark ground illumination so that the small size (about 4μ to 7μ in length) and the appearance of the body as a whole could be observed together with the characteristic movement of the two anterior flagella (one long, the other shorter) and the lateral flagellum, which is attached to the body for part of its length by an undulating membrane. Wet-fixed and dry-fixed films, stained with Heidenhain's iron hæmatoxylin and with Giemsa's stain respectively, were also shown to illustrate the nuclear structure, the axostyle, the parabasal body and the three dots (? blepharoplasts) from which the flagella and axostyle take origin.

Major P. G. EDGE and Mr. L. W. MALCOLM gave a demonstration which comprised an interesting and valuable collection of specimens illustrating curious technical aids employed in securing dependable vital records of primitive peoples, native ideas relating to death, the origins of disease, native methods of treatment of disease, and so on.

Coloured beads, cowrie shells, tally sticks, coloured and knotted strings (adaptations of the ancient Peruvian "Quipus," an actual specimen of which was on view) were made to serve as primitive calculating machines; metal discs played a twofold rôle (1) as much-prized female ornaments, and (2) as dependable registration aids. Numerous other interesting exhibits testified to the medical importance of vital records in backward areas in the tropics and among primitive people, and showed in a practical manner how such records might be introduced and maintained by the employment of methods which were at once simple, attractive, and efficient.

Helminthological Exhibits.

(*A*) Living stages in the development of *Dibothriocephalus mansoni*.—Professor R. T. LEIPER and Mr. W. A. MCDONALD.

(*B*) Some examples of biological control.

(1) Invasion of fluke eggs by a fungus.—Mr. J. J. C. BUCKLEY and Dr. M. J. TRIFFITT.

(2) Invasion of molluscs by a protozoan.—Dr. M. J. TRIFFITT and Mr. W. A. MCDONALD.

(3) Eelworm invasion of insects.—Dr. T. GOODEY and Dr. J. N. OLDHAM.

(*C*) Invasion of the liver of English perch with the larval stage of *Triænophorus nodulosus*, a tapeworm which becomes adult in the pike.—Mr. J. J. C. BUCKLEY, Mr. W. A. MCDONALD, and Professor R. T. LEIPER.

(*D*) Eggs of *Ternidens*, *Trichostrongylus* and *Heterodera* found in the fæces of man in Southern Rhodesia.—Dr. W. K. BLACKIE and Mr. W. A. MCDONALD.

(*E*) Adult specimens of *Schistosoma mattheei* of sheep and *Strongyloides fülleborni* of monkeys obtained from man in Southern Rhodesia.—Dr. W. K. BLACKIE and Mr. W. A. MCDONALD.

(*F*) Sections of liver showing pathological lesion associated with invasion of (1) *Schistosoma mansoni*, (2) *Clonorchis sinensis*, (3) *Stilesia hepatica*, (4) *Hepaticola hepatica*.—Professor R. T. LEIPER.

[*March* 3, 1932.]

The Training and Employment of African Natives as Medical Assistants.

By CLEMENT C. CHESTERMAN, M.D.

SINCE the time of Livingstone there can hardly have been a doctor of any nationality or position who, having spent some years in Africa, has not endeavoured to train his black assistants to minister not only to himself but also to the disease-ridden populations of whose condition we may now not inaptly apply Livingstone's expression "The open sore of Africa," since they are as cruelly bound by disease as by slave-raiding at its worst.

I would personally disclaim any originality or special insight into the problem of training and employing the native medical assistant, my only qualification for addressing you being a firm belief in the value and possibilities of this work and a very modest experience of it during the past eleven years.

Now that the medical departments of the Colonial Governments in Africa have been so successful in securing the health and welfare of their own personnel, they are turning seriously to the task of providing medical and sanitary services for natives in rural areas, but there is a very great diversity of policy and practice in the different colonies, and the time seems ripe for examining the situation as a whole both as regards our aims, our policy and our practice.

The rural problem.—Whatever may be the doubts expressed as to the value of hygiene as opposed to eugenics in overpopulated countries, there can be no misgivings as to the desirability of its application in tropical Africa. Here all are agreed that the greatest asset of a region is its native population, without which no material resources can be developed, but while these latter are comparatively rich, the density of population per square mile is remarkably low. Only in very restricted areas in Central Africa does it exceed fifteen to the square mile, although in Nigeria, Sierra Leone and the Gambia it is in the region of fifty, while the Gold Coast boasts of but twenty-six. Moreover the vast majority of these people live in small villages, often in mere family groups, so that when these figures are compared with the 185 per square mile in India, or the 686 per square mile in Java, they are all the more striking.

Africa, with one fifth of the land surface of the world, has only about one thirteenth of the world's population, yet it is certain that in the greater part of the tropical area it could support a population ten times that of the existing one.

It has been estimated that the slave trade alone has been responsible for depopulation of the continent to the extent of a hundred million souls, but the meagre population persisting in spite of the pacification of the country is due to the presence of disease and the absence of hygiene. The application of our knowledge

is lagging too far behind the acquisition of it. It is always a temptation to the scientifically minded medical man to interest himself in investigating one more of the new things for which Africa has been famous from the times of the Romans, but we have to remember that "knowledge puffeth up" unless applied in charitable actions.

This is the "white man's burden" inasmuch as he is responsible to a large extent for its existence. We must not forget that we have disseminated such scourges as sleeping sickness, tuberculosis and venereal disease. We hope to show, however, that the black man is willing and able to help us shoulder this common burden; he will, in fact, gladly take the heavy end of the stick.

The difficulties.—The difficulties which confront us are however great, and they are not merely geographical or administrative. The very fact of the impact of a white and black civilization means at first decline in population and general health. Thus it was that in Uganda it was only after forty years of our Protectorate that the diminution of the population was arrested and a slight increase recorded. Though it seems to be but a case of "*reculer pour mieux sauter*" it is certainly a distressing fact.

Again, the animistic belief in the spiritual causation of disease, the spiritual agent being either in the flesh in the person of a witch, or in the shades among the departed ancestors, creates suspicion of measures which ignore these beliefs, and ill-directed hygienic efforts, especially when including any sort of compulsion, are often apt to be considered as a new sort of persecution to which they are called upon to submit. To put it on the lowest level, one so as to speak "passes the buck" when their own kith and kin co-operate actively in these tasks, and they are not slow to recognize the obvious benefits of the hypodermic needle, although they will probably explain it simply as affording convenient entry by the puncture to the exorcising power.

When indeed these benefits are withheld or misapplied it often happens that the not uncommon African heretic arises. It is significant that these men, practically without exception, make claims to exercise spiritual, magic, or mental healing, and it is only by co-operation that we shall prevent these excesses and avoid the causing of social distress and individual resentment.

The animist has his own ideas of hygiene, and he believes that he goes deeper than we do to the root of the trouble, for he isolates those who, according to him, *cause* disease (witches, etc.), while we concern ourselves more with those who merely *have* it. It is not however difficult to sublimate his thoughts with the help of the microscope into the real interplay of cause and effect in disease.

It is probable, however, that the accusation of witchcraft and the attendant delay in or neglect of the seeking of modern help for those supposed to be bewitched is the greatest difficulty confronting us at the present time. Some Governments such as that of Nyasaland, where public opinion is sufficiently advanced, have enacted repressive ordinances against these accusations, and I consider that in all colonies those who are sufficiently emancipated to claim it, should be able to rely on the support of the law in defending themselves against them, although repressive measures may have to wait for some generations yet.

The solution.—I have endeavoured to present the situation and its difficulties in such a way as to convince us that the training and employment of subordinate native staffs is the only solution to the problem.

But before taking it for granted, there are some objections which must be met, for there are many who have very little faith in the possibilities of the negro mentality, or of the reliability of those who may have been trained. Many are still obsessed with the altogether erroneous idea that the negro is on a definitely lower plane in the evolutionary scale. If this is on account of his physical characteristics it is certainly erroneous, for they are born practically white, proving pigmentation

to be but an adaptation to environment or natural selection. In this they obviously excel the Caucasian, for who will deny that curly hair and a thick skull are more effective and comfortable than a solar topee, a deep brown iris better than black spectacles, and a quickly radiating and healthily acting skin better than a prickly itching integument clothed in garments sodden with its own perspiration?

Although intelligence tests carried out in America (by white officers examining white and black soldiers) showed a slightly lower intelligence level among the blacks, among children both racial groups were represented in the highest and lowest 3% of each age-group, and in quoting from these reports the late Sir Gordon Guggisberg has italicized in his book "The Future of the Negro" (p. 51) the following lines: "*these differences are not sufficiently marked to warrant the previous popular assumption of the essential inferiority of the negro mind.*"

Many will concede from personal experience the intelligence of the African child, but deplore what appears to be the arrested development at the age of puberty. Without discussing this interesting question in detail, I hazard the opinion that where this phenomenon is observed it seems probable that it is but a protective mechanism used by the normal youth against an education ill-suited to the actual needs of adult life in his environment.

The African youth can and will mount the successive rungs of the educational ladder erected before him, just inasmuch as he sees that it leads somewhere. To start him climbing for climbing's sake is to make him top heavy and apt to lose his balance proportionately to the distance at which he leaves his fellows behind him.

Simple medical education and practice are eminently related to his needs and environment, and in these he can make considerable progress whilst constantly kept in contact with facts. I know of a native assistant so efficient at herniotomy that white men have expressed themselves as perfectly willing to undergo the operation at his hands.

But for the very reason that such knowledge removes him far above the general level of culture, he is correspondingly tempted to abuse his powers, as has been the white man in dealing with primitive peoples, so that for his own good, and for the prestige of the medical service, it is advisable that we should envisage him for some time in the possession of subordinate medical assistant, and not as licensed for private practice.

There are parts of Africa where it has been possible to train men for registrable qualifications, or to employ them when possessing these. It may be advisable to limit the number so trained or employed, but when admitted to organized services it should be on grounds of equality of status and privileges. The highly qualified native practitioner will not, however, solve our rural problems. He will never be content to spend his life in the restricted scope offered by a rural dispensary, even if the medical budget permits of his being posted to such places.

What is most needed is the boy who has had the irreducible minimum of theoretical training, coupled with a sound practical experience in routine treatment and prevention, and who will thereafter work under regular supervision. It must be thorough enough to make him proud of his *métier*, and deep enough to allow of his adding continually to his knowledge from literature and his own observation.

Present-day practice.—Sierra Leone is aiming at the training of 150 medical assistants for employment in 130 dispensaries. The pre-medical standard is to be that of the School Certificate or University matriculation, the attainment of which is possible at the Prince of Wales School. This is to be followed by a four years' course at the Connaught Hospital at Freetown. Graduates will be paid from £160 to £400 a year in Government service, and not allowed private practice. The Committee formed to report on this scheme point to the Kitchener School of Medicine at Khartoum as producing exactly the type of medical assistant which it is hoped to train in Sierra Leone.

The Gold Coast.—The programme in Sierra Leone, outlined above, had been based on a report of the Accra Committee dealing with the subject in the Gold Coast.

Here the training of medical assistants has developed from the Pharmacy School, and with the high standard of general education among the natives, a correspondingly ambitious scheme is envisaged.

A proposition has been considered for the establishment of a Union Medical School for West Africa, but mainly for financial reasons, and possibly also from doubts as to the actual value of such a project, from the larger view-point of general hygienic and medical problems, the scheme has been abandoned for the time being.

Nigeria.—The training of male and female nurses of various grades at provincial hospitals was the first effort made in Nigeria, as far back as 1912. In 1925 a pharmacy school was started at Lagos, and has been very successful in training dispensers and medical store-keepers. This school will shortly be housed in the new buildings being erected for the Lagos Medical School, at which medical assistants and laboratory attendants will also be trained, a start having already been made in temporary quarters. Here, again, the standard aimed at is high, with an entrance examination the equivalent of the Senior Cambridge Local.

The school for nurses at Calabar has also given for many years a very thorough and efficient training.

The Sudan.—Besides laboratory assistants and sanitary overseers there are four categories of subordinate medical workers in the Sudan. These are Dispensary Hakims, who are to be in charge of "A" class dispensaries, recruited from and given a second year's training following the year's course given to the Sanitary Hakims who are to serve the lower of "B" class dispensaries.

Below these two categories is to be found the man who in the Arab areas rejoices in the name of "sanitary barber," conferred after three month's instruction at a provincial hospital, and a similar type for the pagan areas called a sheikh's or chief's dresser. Efforts at the serious training of these classes have perhaps been eclipsed by the éclat of the Kitchener School of Medicine at Khartoum. The following are quotations from the third report of this school written by the Director of Medical Services. Its object is "to ensure as far as possible that the growing need for doctors should be met by training natives of the Sudan and not by importing additional doctors from abroad." The scope of training is "to give in a four years' course a sound scientific, but in certain directions a somewhat simplified, medical training. This four years' course is to be followed in every case by a year spent as house surgeon and house physician at one of the larger hospitals."

In conclusion, the D.M.S. says "Thus nineteen Sudanese doctors are now carrying out medical work in the Sudan, fourteen as Sudanese medical officers and five as house surgeons and house physicians on probation. In every case they are carrying out work which was formerly carried on by Syrian medical officers."

Students are recruited from the Gordon College, and it is hoped to turn out about ten per annum, all of whom will be absorbed in Government service.

Uganda.—A similar scheme to that in operation in Khartoum has been inaugurated at the Mulago hospital at Kampala, with the co-operation of the Makerere college at which students remain for two years studying chemistry, physics, botany and zoology, English and mathematics. Anatomy, physiology and pharmacy form the subjects of the third year, while medicine, surgery and midwifery are studied in the fourth and fifth years.

Besides this effort at creating a class of senior male medical assistants, dressers are trained in the provincial hospitals and employed in more than 60 dispensaries.

The remarkable progress made in Uganda in the training of girls as midwives is outside the scope of this paper, but it is impossible to talk about medical work in Uganda without paying tribute to the wonderful work of the brothers Cook and

their wives and colleagues, who were pioneers also in the training of male medical assistants of high attainments and character.

Tanganyika Territory.—In this vast area, an interesting attempt has been made to tackle the rural problem. Not only are there 81 dispensaries which treated 40,000 cases in 1929, but men of more modest training and pretensions called tribal dressers are formed in a few months at the provincial hospitals and sent to work under the direct authority of a native chief whose people will build him a small dispensary and whose exchequer will pay his salary. Two hundred and fifty of these boys treated in 1930 no less than 190,000 cases, and it is intended to form about 1,000 of these tribal dressers, a proportion of one per 5,000 of the population.

Nyasaland.—A simple training is given to Government dispensers in Nyasaland, of about six months, and there were no less than 82 dispensaries in 1929 at which 130,000 cases were treated.

A more thorough scheme of training has been carried on for many years at the Missions of Blantyre and Livingstonia where students undergo a four or five years' course, and have proved most useful, not only in their own country, but in the neighbouring Rhodesias and Tanganyika Territory. The Government policy seems to be at present to leave this work in the hands of the Missions and not to duplicate machinery.

The Belgian Congo.—There are actually four official medical schools at the provincial capitals of Belgian Congo, in which about 150 students are undergoing a five year course to qualify as *infirmiers*. Pre-medical education required is a proficiency in French and arithmetic, and three years are spent in actual theoretical and practical study, the last two years being passed as a *stage* in some medical or sanitary formation before submitting to the final examination. It is laid down that boys can proceed to the higher grade of *Assistant Médical* by more extensive study, but facilities are actually not available except at the capital, nor is it deemed an urgent matter to provide them elsewhere in face of the great need for the lower class of *infirmier*. In his annual report for 1929 the Médecin-en-chef makes the following observations :

"It is preferable, I think, to confine ourselves for the moment to a condensed medical education suited to the mentality of the pupils which we are able to recruit, and to reserve the higher education for the élite few who are found here and there. Already in French West Africa it has been recognized for two or three years that a too important place has been given to theory, and the curriculum has been changed by reducing the study of pathology and therapeutics to the indispensable minimum for practical efficiency, while developing all that concerns preventive medicine and hygiene."

He expresses himself in favour of the method of training dressers in Uganda, by a practical course at the provincial hospitals without any specialized school or staff, and states that opinion is divided as to the results which have been attained at the Mulago Medical School for the senior assistants, feeling that the greater need is for the larger number of dressers, at any rate as far as Congo is concerned.

I will leave the discussion of the various policies till the end of the paper, but I feel that this limited training of native boys in rural hospitals whether governmental or private, as opposed to concentration at the large hospitals, is not only possible, but a sound policy. Moreover, the employment of such boys in dispensaries established within the radius of action of the rural hospital and its medical organizations, and supervised by the staff of their alma mater furnishes at once the most economical and most efficient solution to the rural problem.

African boys, like the rest of mankind, will, as a rule, give their best service when their attachment is to a person or small group, rather than in a big organization where the personal touch is apt to be lost from the continual change of personnel.

There is nothing new in such a scheme; it has been practised everywhere in Africa for years, but before the recent economic crisis, big ideas had been born and fostered and more humble offspring had perhaps been neglected. I venture, therefore, to give more detailed information of efforts made at a Mission hospital since the year 1920.

Experiences at Yakusu, Belgian Congo.—The most important equipment for a teaching hospital is first, patients, second, patients and third, more patients. For the medical staff it is the same thing spelt with a "ce."

If there is a roomy and well-equipped pharmacy and laboratory little other accommodation is required with the exception of a good lecture-room with suitable anatomical charts, a skeleton and various wall pictures. In building a hospital at which training is to be an important function, special attention should be paid to assuring facilities for easy supervision of all departments by a limited staff, and instead of separate buildings being erected for the various departments, a single large administrative block is preferable. Admission of students is by competitive examination, the important subjects being French, and arithmetic in which a knowledge of the four rules and the decimal system is indispensable. Boys are accepted between the ages of 13 and 20, are provided with uniform and rations, and live in a hostel.

The curriculum is intended to cover three years. Practice and theory are combined from the start, and in each of the three classes all boys are delegated in monthly rotation to the performance of duties suited to their year, while lectures are given in the afternoons. Thus each boy, during his course, will have fulfilled more than once the following functions:—In the wards: Ward-maid, ward dresser, recording temperatures, pulses and respirations, etc., giving treatments. In the out-patient department.—Dressing wounds, giving injections, routine pathological examinations, dispensing, medical treatments and sale of drugs, theatre assistant, post-mortem clerk, etc.

In the laboratory and pharmacy a second-year student works with a third-year boy. The third-year boys will also get practice in minor surgery and at consultations and record keeping with a graduate who is acting as monitor.

It is possible to unite first and second-year classes in some subjects and second and third in others, so that a teaching staff of two is actually sufficient.

The subjects taught are as follows: *First year*: vocabulary of medical terms (French-native language), anatomy and physiology (taught together), surgical diseases; *second year*: anatomy and physiology, surgical diseases, pharmacology and dispensing, clinical pathology, medical diseases; *third year*: pharmacology and dispensing, clinical pathology, medical diseases.

Hygiene and entomology (and helminthology) are taught not as special subjects, but in their appropriate places in the study of diseases and their prevention.

To facilitate these studies we have combined the above subjects (excluding anatomy and physiology) in a single textbook entitled the "African Dispensary Handbook," the second edition of which, together with a French translation, is shortly to appear.

After qualification boys are, as a rule, employed as monitors for a year at the training hospital before being sent to a rural dispensary or subsidiary medical post. They contract to give at least three years' service after qualification and start at a salary of about £2 a month.

The rural dispensary is a simple affair of wattle and daub or more permanent material, with but one lock-up room behind a large half-walled verandah which serves also as a dressing room. All necessary dispensing material for making up stock drugs is provided, together with a microscope and laboratory equipment. A table covered with a zinc sheet serves for minor surgery, and a few huts serve as lodgings for patients who come from a distance or are seriously ill, but no effort has

been made to cater for in-patients. Standard fees are charged, calculated to cover the cost of drugs and dressings only, but the principle of charging something is, in my opinion, a sound one. Certain drugs and dressings should also be on sale.

It is our intention to place these dispensaries at central market villages not less than fifteen miles apart, and to develop round them welfare centres visited once a week by a second assistant or, if practicable, by a trained woman.

The unit organization is therefore the rural hospital with its ring of say twenty village dispensaries and up to one hundred smaller welfare centres. The minimum white staff required for such a unit would be two doctors and two nurses, but senior native medical assistants, where available, might well take a large share of both the teaching work at the hospital and the visitation of outposts.

Where good roads exist, visitation would be possible every three months, but we have found that boys are capable of rendering faithful and efficient service even when regular visitation is limited to once or twice a year. Of course there must be easy communication for the return of reports and the receipt of supplies.

The Policy Advocated.—Such work is, of course, the duty, although not the sole prerogative, of Governments, and as an outsider, but one who has not been merely a looker-on at what is being done, I venture to make a few suggestions to those who are responsible for framing policies.

It seems to me that perhaps without creating a totally new department of the medical and sanitary services, an A.D.M.S. should be appointed in each colony with the supervision of medical education as his special duty. In the larger colonies a new category of medical officers who are specially interested in this work might be formed and such men encouraged to look upon the life as a career in which they will be eligible for promotion and the appointment to the teaching posts of the higher medical schools, and administrative posts. It is important, however, that the medical officer engaged in teaching should also be practising at the rural hospital and should take a large share in the visitation of the village dispensaries.

The A.D.M.S. (Education) would be responsible under the D.M.S. for the posting and advancement of the subordinate staff and for unifying the educational programme, textbooks and examinations. I would urge that the metric system be introduced at the earliest possible moment into all pharmacies and medical schools, just as the decimal system for coinage has been adopted in parts of British Africa.

Besides nurses, who are in a class apart, there are many other grades of assistants such as laboratory attendants, sanitary inspectors and dispensers who might also be the special care of the A.D.M.S. (Education). Dispensing should be so simplified in these days of specific medication, that the need for the creation of a special class of dispensers seems to me to be open to question.

The training of the medical assistant is of great importance, and where more efficient dispensers and laboratory attendants are required they might be recruited from this class and trained when needed.

The question of advanced medical education seems to be bound up in Africa with politics more than with hygiene.

That it *can* be done is not questioned on any other ground than that of expense. Perhaps the hardest person to persuade that he ought to be given facilities for medical graduation in his own country will be the African himself, for it appears to be his great ambition, like that of the Indian, to obtain a British degree.

While it is certain that the medical services must not be behind in providing for the gradual replacement of European personnel by natives properly trained for their duties, yet we must not imagine that by concentrating our efforts on advanced medical education we are going to discharge our responsibilities to the ignorant masses of the population. It will take a long time for the ideals of social service to be developed in the ambitious African graduate, and there will not be many who will be content to devote themselves to perpetual "panel" practice.

The rural problem can only be tackled effectively by the creation of a class of native "general practitioners" who will not have undergone the detribalizing and often demoralizing process associated with the larger centres, and in whom all that is best in the native socialistic society has been preserved.

It is significant that in the larger colonies, French West Africa, the Belgian Congo and Tanganyika Territory higher education has either been modified after trial or not seriously contemplated. This may be due to the lower standard of general education which prevails in these parts, but it is also due to a clear realization of the problem. Tanganyika territory has concentrated on the scantily trained tribal dresser with the idea of completely covering the area before doing anything more thorough. The association of these boys with tribal authorities is in keeping with the policy of indirect government. It remains to be seen whether such boys will continue to do good service with such meagre training and scope.

I hope that the new spirit of co-operation between missions and Governments in Africa, based on mutual appreciation of ideals and difficulties, will be further extended into the realm of rural hygiene, and that many of my own fraternity will be stimulated to make greater efforts in this direction.

Let us not be deterred by catch phrases such as "A little knowledge is a dangerous thing." Anyone who has really faced the problem on the spot, knows that a lot of ignorance is a much more dangerous thing. The "inevitableness of gradualness" is another slogan often used in dealing with primitive races, but unfortunately this is not always applicable to the progress of disease and depopulation, against which we must often advance swiftly, but in co-operation with the people.

I cannot conclude better than by a quotation from one of Africa's greatest sons, the late J. E. K. Aggrey: "You can play some sort of a tune on the white notes of a piano, you can play some sort of a tune on the black notes, but to produce real harmony you must play the black and the white notes."

Discussion.—Mr. J. HOWARD COOK said that he spoke as a visitor representing the work of the Church Missionary Society in Uganda. The C.M.S. hospital at Mengo had been engaged in the training of African medical assistants since the foundation of this hospital in 1897. At first it was only possible, with the very raw material available, to train ward orderlies and ward maids or unqualified nurses, but they had proved their capacity for doing valuable work in the time of epidemics of smallpox, sleeping sickness, and other diseases, and one of them had saved the life of the native King of Uganda when critically ill with double pneumonia, the native Parliament rewarding him by making him a Chief and giving him a square mile of ground. In 1917 a medical school was opened which gives a four years' curriculum and trains Baganda lads of the best type up to the grade of clinical assistants with a Government certificate. Between forty and fifty such lads had been trained up to date and the present class numbers twenty. Excellent work has been done by many of the certificated pupils, both in Government and Mission employ. In 1919 a large Maternity Training School was founded for the training of native midwives. As recently as 1922 the infant mortality in the country was over 500 per 1,000 and in parts of the Protectorate indubitably much higher. Legislation was enacted to initiate a Uganda Midwives' Board and ninety-nine of the students of this institution have passed the C.M.B. diploma on the same standard as the examination in England. These are at work in thirty welfare centres scattered over the Protectorate and annually over 100,000 attendances are registered in the welfare centres which are under their charge. In the central institution over 600 confinements are attended by the students. The infant mortality of the Protectorate as a whole dropped to 257 per 1,000 in the first ten years' work of these qualified students from the Lady Coryndon Maternity Training School in connection with Mengo Hospital, and in the Kingdom of Buganda, where the most intensive work of these young African midwives is being carried on, the infant mortality in 1930 had dropped to 130 per 1,000. In the actual practice of these midwives in their Centres the infant mortality was between 60 and 70 per 1,000 only. In 1931 a Nurses' Training Institution was founded by the Mengo Hospital at Ndeje, twenty-three miles north of Kampala, and Baganda women now have a three years' curriculum, after which, if successful in various examinations, they receive

a Government diploma as fully qualified nurses and the C.M.B. certificate as well. Four of the Baganda hold the higher certificate of Diploma in Midwifery (D.M.), which enables them to practise operative midwifery. There is a practising school at Namulonge in charge of a Muganda midwife, Agiri Uja, D.M.

With reference to policy in the training of the African, four principles should be recognized:—

(1) Early training, pre-medical and welfare, and simple village hygiene, should be in the vernacular. A higher medical and nursing training in English. (2) Training should be intensive rather than extensive, aiming in the first instance at producing a few thoroughly reliable workers rather than a number of less reliable diplomates, and as the credit of the work will depend on the character of the men and women trained, every care should be taken in their selection and moral supervision and training. (3) All medical training should keep the right balance between theory and practice. The African who is trained in theory only, gets a swelled head and is often useless when it comes to practical work. (4) All elementary education should be correlated to the needs of rural village life.

Dr. H. J. SMYLY said that although China was far removed from Africa in civilization as well as distance, the introduction of scientific methods in that country presented similar problems. Mission hospitals in China had from the first undertaken the training of native medical assistants. As time went on this work grew by degrees to larger proportions and increased efficiency until now there were six medical schools in China run by missionary societies, in addition to the splendid and well-known institution under the Rockefeller Foundation, the Peiping Union Medical College. He was surprised to hear Dr. Chesterman advocate an inferior grade of training, as in China both Chinese and foreign physicians were agreed that thorough training in scientific methods was essential if modern medicine was not to be discredited. A clear case however had been made out from direct experience. He believed, however, that progress would continue as it had continued in China, and that the time would come for thorough training in medical science for the African natives.

Dr. GEORGE W. BRAY said that in Nauru Island in the Central Pacific he had faced problems similar to Dr. Chesterman's.

For administrative purposes the island was divided into fourteen natural districts each presided over by a chief, who was subservient to a head chief. Together they formed the advisory council of the Government. Each month the chiefs and district constables met, and after being addressed by the administrator on matters of government, were then addressed by the medical officer on matters appertaining to health and sanitary problems. The chief points were set out on printed slips, from which the chiefs, on their return home, addressed a meeting of the whole of their district according to rôle.

When he (Dr. Bray) first went to the island, 50% of the infants born in a year died before the first anniversary of their birthday. He showed that these deaths were due to a deficiency of vitamin B in the mother's diet and could be prevented by the administration of an emulsion of toddy yeast. This necessitated the formation of baby clinics at which each baby was obliged to attend each week from birth. So the hospital had to train both male and female orderlies, and at the same time the opportunity was taken to teach a small class of girls who had just left school the rudiments of baby care and attention. In the first place they would soon be prospective mothers, according to the native fashion of marrying young, and secondly, each was made responsible for visiting and assisting any mother in her district in attending to the welfare of her baby. Each of these girls was instructed in the management of a normal labour, and attended each prospective mother in her district, and managed the confinement under the supervision of the medical officer or matron. So successful had these measures proved that the infantile mortality-rate had been reduced 75% in the last five years.

The whole of the injection treatment at the out-patient clinic for leprosy was managed by native orderlies under the direction of the medical officer, and about 60,000 injections a year were given. The orderly in the leper lazaret also attended to the minor ailments, and the wards and operating theatres. In the administrative work he was assisted in his duties by two chiefs and six constables who attended to the carrying out of public health schemes and sanitation as well as the maintenance of order and the ensuring that the more infectious cases did not mix with the less infectious. In addition to diet and cleanliness, every opportunity was taken of ensuring physical fitness, and drilling squads, and boy scout and football teams have been formed, and the individual members take a keen interest in their physical fitness and prowess.

The result of this endeavour to teach natives to govern and treat themselves had been to produce, with but one white medical officer and matron, one of the healthiest and most conscientious native tribes that was known, which, though a decade ago they had been decreasing in numbers, were now rapidly increasing; and of the two great causes of death the first, the high infantile mortality, had been wiped out, and the second—the spread of infectious disease—had been prevented, and leprosy was rapidly on the decline following the segregation of infectious cases.

He believed that a special school had been formed in Samoa for the training of native medical orderlies, and was very popular amongst candidates from all the Pacific groups. From our experiences at Nauru a similar college for the training of native nurses is warranted.

References.—BRAY, G. W., "The Story of Leprosy at Nauru," *Proceedings*, 1930, xxiii (Sect. Trop. Dis.), 1370; Id., "Vitamin B deficiency in infants—its possibility, prevalence and prophylaxis," *Proc. Roy. Soc. Trop. Med. and Hyg.*, 1928-9, xxii, 9.

Section of Orthopædics.

President—Mr. HARRY PLATT, M.S.

[*January 5, 1932.*]

Synovial Angioma of the Knee-joint.—H. J. SEDDON, F.R.C.S.

C.C., male, aged 21, warehouseman.

History : Vague recollection of trouble with the knee in infancy. 10 years ago had " synovitis " in left knee after mild football injuries. Caliper splint ordered and worn for one year. Four and a half years ago, a similar attack. No caliper worn. Four years ago, spontaneous effusions. Since this time there have been recurrent effusions lasting three to four weeks. The joint has never given way or locked.

March, 1931 : Came to hospital on account of swelling and pain in the joint.

Physical examination.—3 in. wasting of the thigh, 1 in. wasting of the calf. No puffiness of the knee, but a soft hemispherical acutely tender swelling is palpable anterior to the external lateral ligament. When the knee is flexed this swelling almost disappears and a similar swelling half inch in diameter appears at the upper and outer pole of the patella. The range of movement in the joint is 0° to 110° flexion. There is no lateral instability. Skiagrams negative.

March 14, 1931 : Exploration by exhibitor. Esmarch bandage applied. A cavernous angioma discovered lying under the capsule except in the two places where the swellings appeared clinically.

April 2, 1931 : Excision of tumour by Mr. Harold Wilson, Esmarch bandage applied. Scar of exploratory operation excised. Capsule incised longitudinally half inch lateral to patella—then horizontally quarter inch above external semilunar cartilage ; flap of capsule thrown upwards and backwards. The tumour was easily removed as it was confined to the synovial layer except in the two places where it had herniated through the capsule. It was not necessary to divide the external lateral ligament. The " pedicle " of the tumour was continuous with the external inferior articular vessels. These were tied. A large gap in the synovial membrane remained but the capsule was closed without difficulty.

Pathological report (St. Bartholomew's Hospital).—Cavernous angioma.

January, 1932 : Patient is well satisfied with the joint ; range of movement as before : no pain.

Two Cases of Adolescent Coxa Vara.—NORMAN CAPENER, F.R.C.S.

(I) A normal female child, aged 11, but having the appearance of an obese girl of 15, fell four days previously, and injured her right hip ; following which she was unable to walk and had severe pain.

Condition on examination.—Patient was in acute pain. Temperature 101·4° F. ; pulse 108.

The diagnosis of slipped upper femoral epiphysis was made by radiography.

Treatment was by manipulation under anæsthetic, the femur being slowly abducted, extended and internally rotated ; position maintained in a plaster spica.

Four weeks later the cast was bivalved, and massage and movements of the hip were begun. Two months and a half after the commencement of treatment the patient was allowed up in a non-weight-bearing caliper which was used for four months

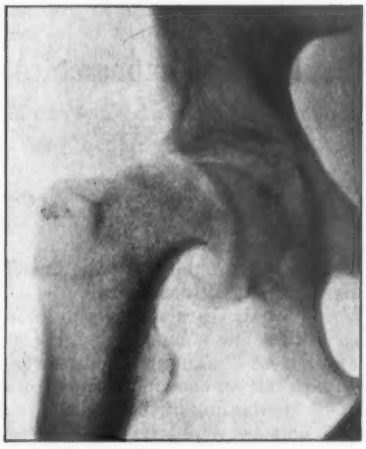

FIG. 1.—Right hip before treatment.

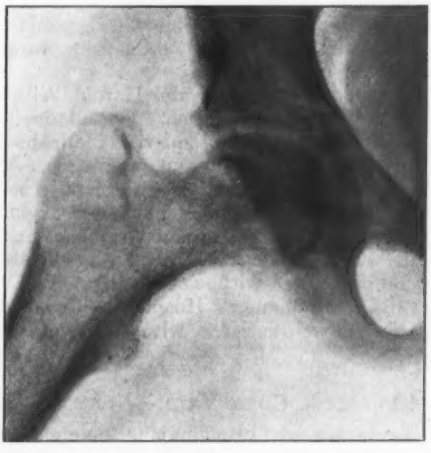

FIG. 2.—Right hip, three months after reduction. Slight relative increased density of head of femur.

before weight was allowed to be borne upon the right lower extremity. A year after the onset of the trouble there was an excellent range of painless movement, full abduction was possible but flexion and internal rotation were a little limited.

The first skiagram shown was taken before treatment (fig. 1), the second three

months after reduction (fig. 2), the last, eleven months after reduction (fig. 3). They show in succession the characteristic epiphyseal displacement, complete reduction of the deformity, and finally a flattening and sclerosis of the head, somewhat reminiscent of Perthes' disease.

(II) A normal-looking boy aged 15 who, a week before admission to hospital, was thrown from a scooter, striking his left hip. As in the previous case the temperature was elevated to 100·8° F. and the pulse-rate was 116. The clinical diagnosis of acute epiphyseal coxa vara was confirmed radiographically and under anæsthesia the hip was manœuvred, as in the former case, into Whitman's position

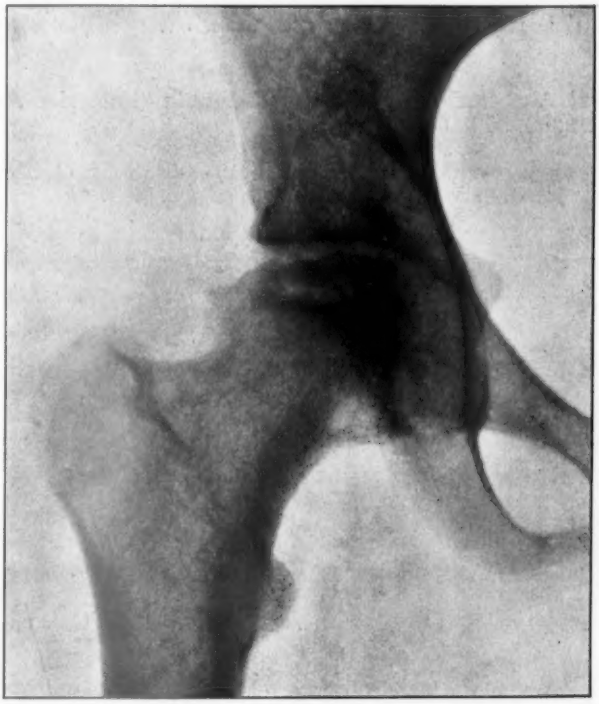

FIG. 3.—Right hip, eleven months after reduction. Sclerosis and compression of head. (? "Anæmic aseptic necrosis.")

and retained in a plaster spica, this time, however, for nine weeks. Following the removal of the plaster the patient was protected for six months from weight-bearing on the affected side by a caliper.

Fourteen months after the onset of the lesion the affected hip appeared to be practically normal, both radiologically and clinically.

Comments.—In discussing these cases I wish to draw attention to the fever present in both on admission. As the cause of this, the possibility of an associated

infectious metaphysitis must be considered, in view of the X-ray appearances of the first case. The fever subsided, however, immediately the patients were immobilized and in my opinion was due to intra-articular hæmorrhage.

In the first case I would like to ask what was the cause of the imperfect revascularization of the femoral head? In comparison with the second case I would suggest that too brief a period of immobilization and too early weight-bearing were large factors in this less satisfactory result. On the other hand another possible factor should be borne in mind: the patient was much younger (chronologically) and the cartilaginous epiphyseal disc may have been much thicker than in the older patient and therefore have proved a greater obstacle (after separation and replacement) to the passage of new vascular tissue.

Regarding treatment, I think that both cases show favourable results following immediate forcible reduction under an anæsthetic, but that prolonged protection from weight-bearing is necessary.

Congenital Abnormality of Tibia and Fibula (Posterior Angulation).—ST. J. D. BUXTON. F.R.C.S.

P. A., a boy aged 5 years and 3 months.

The right foot appeared to be a congenital calcaneus, but the lower third of the leg was deformed; angulation backward could be seen and felt.

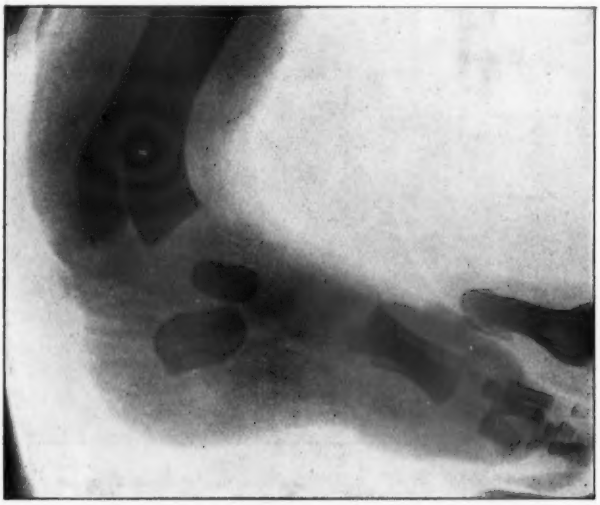

FIG. 1.—Right leg at age of 10 months.

At the age of 5 months osteotomy was performed on tibia and fibula. It was difficult to keep the plaster on the leg and valgus deformity of the foot was a constant trouble.

The child has now a straight leg.

This case is shown as one of a rare congenital abnormality, as angulation of the tibia at birth is usually forwards.

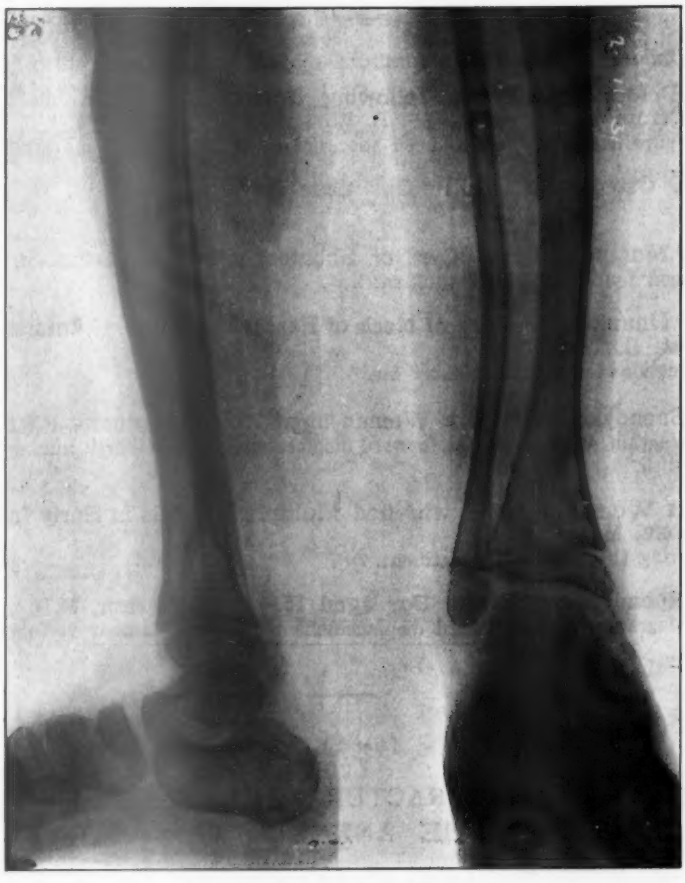

FIG. 2.—Right leg at age of 5 years.

The following cases were also shown :—

Fracture of Tibial Spine.—ST. J. D. BUXTON, F.R.C.S.

Congenital Abnormality in three Generations.—D. MCCRAE AITKEN, F.R.C.S.

The Result of Bolderin's Operation (Pseudo-arthrosis of lower end of Ulna) for Malunited Fracture of Radius and Ulna.—R. W. BUTLER, F.R.C.S.

Large Rarefied Area in Tuber Ischii : Case for Diagnosis.—R. W. BUTLER, F.R.C.S.

Rigid Kyphosis of Adolescence.—E. P. BROCKMAN, M.CH.

[*February* 2, 1932.]

The following cases were shown:—

(1) **Deformity of Wrist following Destruction of the Shaft of the Radius from Osteomyelitis.**—P. B. ROTH, F.R.C.S.
The gap in the radius had been successfully bridged by a bone graft.

(2) **? Osteomyelitis of Pubis. Case for Diagnosis.**—W. H. OGILVIE, M.Ch.

(3) **? Morant Baker's Cyst of Shoulder-joint.**—R. MARNHAM, F.R.C.S. (introduced by Mr. E. P. BROCKMAN).

(4) **? Ununited Fracture of Neck of Femur in a Child. ? Infantile Coxa Vara.**—A. H. TODD, M.S.
Suggestions for treatment asked for.

(5) **Spondylolithesis in a Woman aged 75.**—B. H. BURNS, F.R.C.S.
A skiagram showed partial forward displacement of the fourth lumbar vertebra on the fifth.

(6) **A Woman aged 29, who had Multiple Arthritis in Early Infancy.**—R. BROOKE, M.S.
Showing the results of treatment.

(7) **Spondylolithesis in a Boy aged 15.**—G. O. TIPPETT, M.B.
A skiagram showed forward displacement of the fifth lumbar vertebra on the sacrum.

[*March* 1, 1932.]

DISCUSSION ON FRACTURES IN THE REGION OF THE ANKLE-JOINT.

Mr. R. Broomhead: I shall give a classification of the fractures as a basis upon which to construct ideas and lay lines of treatment for subsequent discussion. I shall use the classification of abduction and adduction fracture-dislocations. (See figs.)

Both classes of fracture are due to indirect violence, the abduction variety being the result of torsion on the leg with the foot fixed and the knee slightly flexed, whereas the abduction variety is caused by simple leverage. The type of fracture depends upon the character of the force; the displacement depends upon the extent and duration of the force.

Abduction fractures.—There are three degrees of these. (1) In the first degree the internal lateral ligament is intact, while the lower end of the fibula is fractured from above downwards and from behind forwards in the coronal plane—in this fracture there is no displacement.

(2) In the second degree the fibula is fractured as before, but in addition there is either tearing of the internal lateral ligament of the ankle-joint or fracture of the internal malleolus; the astragalus is displaced outward as well as tilted outwards. Occasionally the inferior tibio-fibular ligament is ruptured.

(3) Third degree fractures have the features of the second degree but, in addition, there is posterior displacement of the astragalus, and with this the posterior malleolus may be fractured. These are the classical Pott's and Dupuytren's fractures.

Adduction fractures are of two degrees. (1) In the first degree there is a transverse fracture of the external malleolus, and a vertical fracture of the internal malleolus, but there is no displacement of the astragalus.

(2) In the second degree both malleoli are fractured as in the first degree, but the astragalus is displaced inwards. This displacement, when severe, is often

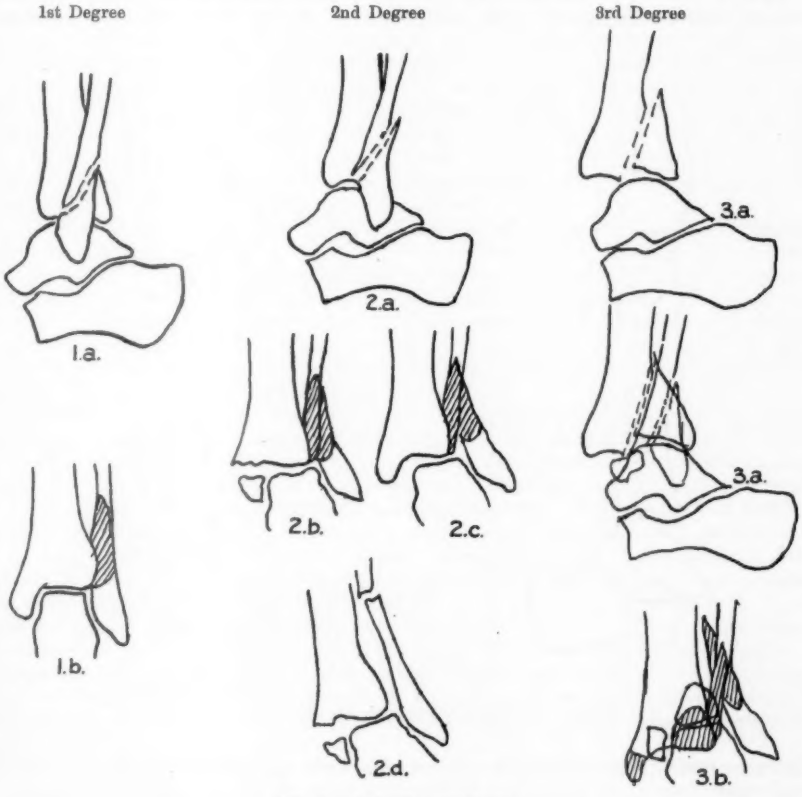

FIG. 1.—Abduction fractures.

complicated by a fracture of the anterior margin of the tibia and anterior dislocation of the astragalus.

Treatment.—Treatment in these, as in all fractures, depends upon displacement.

Fractures without displacement.—When there is no displacement there is no need to immobilize the foot.

If the patient is seen immediately after the accident, swelling can be prevented by firmly applying alternate layers of wool and bandage to the leg and foot. The patient is allowed to walk towards the end of the first week. On the other hand,

if swelling is present when the patient is first seen, it is better to wait until it has subsided before walking is allowed. Massage and active movements should begin in the former cases when the wool is removed, and in the latter cases immediately in order to aid the absorption of blood and œdema.

When walking is begun, a firm though mobile support should be used to prevent the recurrence of swelling; flannel, crêpe and starch bandages all serve this purpose, but the starch bandage is particularly useful. It is advisable to support fractures caused by abduction violence with a flat-foot adjustment, although the adduction variety are perfectly safe in an ordinary shoe.

Fractures with displacement.—When reduction is possible, it is easy; there is no need to discuss the method of manipulation. Those fractures which present

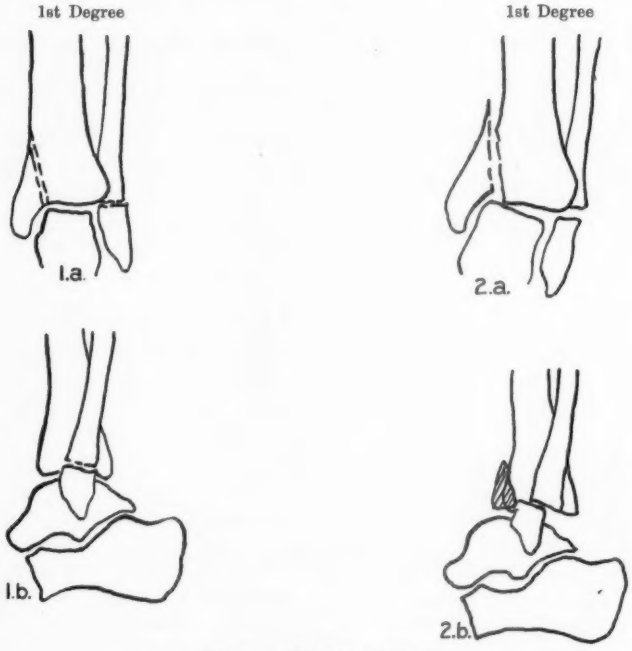

FIG. 2.—Adduction fractures.

difficulty often prove irreducible and require open operation, a matter to which I shall refer later.

The position in which the foot should be maintained after reduction arouses controversy; some surgeons advise full inversion, while others lay stress on the correction of the lateral displacement. In abduction fractures a certain amount of inversion is necessary to bring the surfaces of the fractured internal malleolus into apposition; this inversion, however, should be obtained not by twisting the fore-foot but by inverting the back-foot and by pushing the astragalus and os calcis medially into their correct positions. In adduction fractures the foot should be fixed at a right angle with neither inversion nor eversion.

Ambulatory treatment of displaced fractures.—One of the best known and most widely used methods of ambulatory treatment is that of Delbet. He himself applies

the plaster as soon as the fracture is reduced, and advises walking immediately. As the swelling diminishes the plaster becomes loose and a fresh one has to be applied —possibly on two or three occasions—in order that the plaster shall fit the limb. It has been our practice, when using Delbet plasters, to fix the limb after reduction of the fracture by one of two methods. In the first we use a long external gutter splint which is curved round the foot to dorsiflex and invert it while a short gutter splint is placed on the inner aspect of the leg to assist immobilization; in the second, we use a back-splint, foot-piece, and side-pieces. Whichever method may have been used, the plaster is not applied until the swelling has been absorbed, usually in about a week. We found it inconvenient to allow the patient to walk with a sock over the plaster, and special shoes, fitted with flat-foot adjustments, have been made to be worn over the plaster. They are a great help and each one can be used many times. The patients walk with the shoe over the plaster, and in six or eight weeks, when the plaster is removed, they are supplied with the usual outside iron, valgus T-strap and flat-foot adjustment. Other ambulatory methods take the form of applying plaster cases and, of these, that devised by Böhler appears to be the most practicable. He uses a skin-tight plaster in which is incorporated an iron hoop projecting a little below the plaster and upon which the patient walks. Böhler, however, does not allow walking until all swelling has been absorbed.

Recumbent method.—In this method, after reduction has been effected, a plaster case is applied and the limb is immobilized for three or four weeks, a period which is followed by removal of the plaster and by the use of physiotherapy. Walking is not allowed for from six to eight weeks, the heavier patients resting for the longer period. The circulation of the limb should be aided by the wearing of a flannel, crêpe, or starch bandage to prevent œdema. As a support for the leg and in order to prevent the development of a traumatic flat-foot, we always order an outside-iron, flat-foot adjustment and valgus T-strap.

Ambulatory versus recumbent treatment.—Personally, I am in favour of the recumbent method. As a retentive splint in fractures in the region of the ankle, plaster is ideal, but when it is used as a corrective splint, pressure troubles are apt to occur. A Delbet plaster is difficult to apply in such a way that it allows free dorsi- and planti-flexion at the ankle without lateral instability, and in such a way that the ankle is held firmly and weight is transmitted through the plaster without pressure sores being caused and without the foot being converted into an immobile mass. We must remember that the whole weight of the body has to be carried by the plaster and if the fitting of the plaster is not correct, grave strain and stress will be placed upon the young callus and displacements will tend to occur. When we remember the safety of the recumbent treatment I think caution should be used before a change is made to a method full of potential dangers and difficulties. No one has yet brought forward convincing evidence to prove that miners and labourers are able to return to work any sooner when treated by ambulatory rather than by recumbent methods.

Cases requiring operation.—The cases which require open correction of the deformity are, firstly, some of the third degree abduction fractures, particularly when the posterior malleolus has been broken; secondly, many of the second degree adduction fractures, especially if the anterior articular margin of the tibia be torn; and thirdly, all compound fractures.

When to operate.—Although it is safe to operate upon some fractures in the presence of swelling such a course is dangerous if followed in cases of fracture-dislocation of the ankle. The potentiality of sepsis in the skin of the foot is great—particularly in those patients whose injuries are received at work which, in the North, is apt to be dirty—and it is, therefore, advisable not to operate until the swelling has subsided and the skin of the foot has been prepared—a matter of seven to ten days. Reduction of these fractures is no easier by open operation than by closed

manipulation and when reduction has been effected the position is difficult to maintain. There are two incisions used for exploring such fractures, both of which may be necessary. The inner incision is situated midway between the posterior border of the tibia and the inner border of the tendo Achillis and, passing below the internal malleolus to the inner margin of the foot, allows both internal and posterior malleoli to be reached. The outer incision passes downwards behind the fibula and below the external malleolus to the outer border of the foot, and exposes the external malleolus. The displaced fragments must be fixed securely as they are subject to great strain and as bone-pegs are insufficient for this purpose, plates or screws are required.

In adduction fractures the internal malleolus and in abduction fractures the external malleolus must be fixed, and, in addition, it is often necessary to fix the posterior malleolus.

It is wiser subsequently to remove the plates and screws whether or not they appear to be causing trouble, as large pieces of metal must have a deleterious action on the adjacent articular cartilage of the ankle-joint.

There are two procedures alternative to immediate open correction of irreducible fracture-dislocations; one depends upon the experience of the surgeon, the other upon the function which is a result of treatment by the closed method. The first alternative is to wait for about a fortnight until the swelling has been absorbed and then to fuse the ankle-joint. The second alternative is to allow the patient to obtain the best result possible from conservative means and then, if the function of the ankle in six months or so is insufficient for his purpose, to fuse the ankle-joint. As the second of these procedures is based upon the function of the foot rather than upon the experience of the surgeon, it is surely the sounder one to adopt. I mention the first method quite tentatively as I have no experience of it, but I suggest that in selected cases much time would be saved if such a course were followed.

Compound fractures.—It has been our practice to excise the wound, to reduce the fracture and to put the limb into plaster—with a window, lest the wound should require dressing. During the last two or three years we have used vaseline-pack dressings and have found them most satisfactory, even, or perhaps particularly, when there have been extensive lacerations. When the compound fracture is severe, primary amputation is the best procedure, for should the patient retain his limb, he must pass through a long period of extreme discomfort only to find a foot permanently disabled owing to stiffness and the presence of tender scars.

Separated epiphyses.—I have a few interesting skiagrams of separated epiphyses of the lower end of the tibia which show progressive degrees of deformity and displacement. It is important to reduce the displacement at once in these cases as union occurs early and failure of reduction results in alteration of growth and crippling deformity. It is often difficult to reduce the displacement of a separated epiphysis; for this, a much greater force than that used for ordinary fracture-dislocation in adults is required.

Anæsthesia in the reduction of fracture-dislocations of the ankle-joint.—It has been our practice to use general anæsthesia for the fractures which require reduction. We have, however, used local anæsthesia to form an estimate of its value and have been dissatified with it. When a method of treatment is satisfactory the superiority of any alternative must be proved before that method should be changed. The injection of from 20 to 30 c.c. of fluid, which is necessary for local anæsthesia, into an already swollen and bruised limb puts increased strain upon a damaged and embarrassed circulation. This additional swelling adds a further difficulty to ambulatory treatment because the time when an efficient corrective walking plaster may be applied is delayed. Again, in many cases a local anæsthetic does not abolish the spasm of the peroneal muscles, and although the dislocation can be reduced—it could be

reduced just as easily without an anæsthetic—when the hands are removed from the foot, the peroneal muscles often go into spasm and flick the astragalus back into its dislocated position. On the other hand, general anæsthesia completely relaxes the muscles and reduction can be maintained until some form of splint is applied, while, in addition, general anæsthesia is simple to obtain and need be so short that the danger of any complication is minimal.

Prognosis and summary.—In view of the increasing importance of the relationship of injuries to compensation claims, I think we should attempt to correlate the type of fracture sustained with the period which must elapse before working function returns.

In cases of fractures with no displacement, the return to former work, however heavy, should be made in from eight to ten weeks. In cases of fractures with displacement, the period of recovery is much lengthened when there is either an anterior or a posterior marginal fracture of the tibia, irrespective of the degree of displacement. In those cases in which a marginal fracture is not present, return to labouring work should be expected in from sixteen to eighteen weeks, whereas the addition of a marginal fracture increases the period of disability by at least six or eight weeks. In some of the cases which require operation the patients recover working function in from sixteen to eighteen weeks, but the majority are disabled for at least six months. Those patients who have sustained a separated epiphysis of the lower end of the tibia should have made a full recovery in three months.

The degrees of trauma and sepsis in compound fractures are so variable that no attempt at prognosis should be made.

Mr. J. P. Hosford: Of the three bones in the ankle-joint, the astragalus is much the least commonly fractured. I have only been able to obtain the records of fifteen which have occurred at St. Bartholomew's Hospital during the last ten years. The fifteen fractures occurred in thirteen patients, the condition in two instances being bilateral. The reason for this infrequency of fracture probably lies in two factors, (1) the protected position of the bone, and (2) its compact shape; indeed the parts of the bone most commonly fractured, except in those cases of great trauma in which several bones are injured, are the projecting portions, both anterior and posterior, the neck being the commonest site of fracture. Some fractures of the astragalus involve the ankle-joint while others are outside it; but all, owing to their close proximity to the joint, usually present difficulty in diagnosis from actual lesions of the ankle.

Traumata may be applied to the region of the ankle in at least three different ways: (1) A direct blow, (2) an abduction or adduction injury, and (3) a fall on the foot from a height. A direct blow rarely fractures the astragalus, because it is protected by the internal and external malleoli at each side. In the case of an adduction or abduction injury or a twisting strain, the internal and external malleoli fracture more easily than the astragalus, the latter being more compact in shape. In the case of a violent fall on to the heel, the os calcis bears the brunt of the impact and a compression fracture of this bone is a common condition. Actually, however, this is also the commonest method by which a fracture of the astragalus occurs; in nine of the thirteen patients the trauma causing the fracture was a fall on to the feet from a height. Out of sixty-one patients, Gaupp found that this was the cause of fracture in forty-five, i.e., over 70%.

Not infrequently a fracture of the astragalus is associated with some other gross lesion in the tarsus, either a fracture or dislocation. In this series of fifteen fractures, six were associated with fractures of other bones of the tarsus, three with a subastragaloid dislocation, and in the remaining six instances the fracture of the astragalus was an isolated lesion.

Fractures of the astragalus, although many of them are irregular, may be

classified as follows: (1) Fractures of the neck of the astragalus (figs. 1 and 2), five; (2) crush fractures of the body of the bone, five; (3) fractures of posterior process, three; (4) chip fractures off some portion of the bone (fig. 5), two.

Mechanism of fracture and displacement of fragments.—The mechanism of

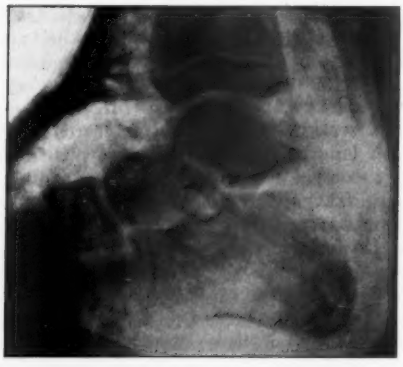

FIG. 1.—Fracture of neck of astragalus. In plaster.

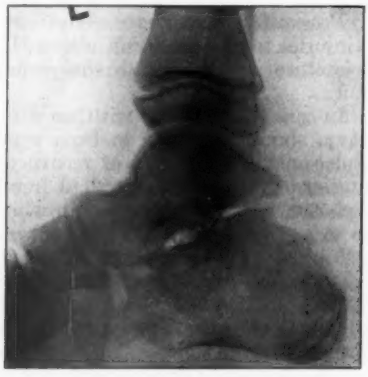

FIG. 2.—Fracture of neck of astragalus—united. Same as Fig. 1.

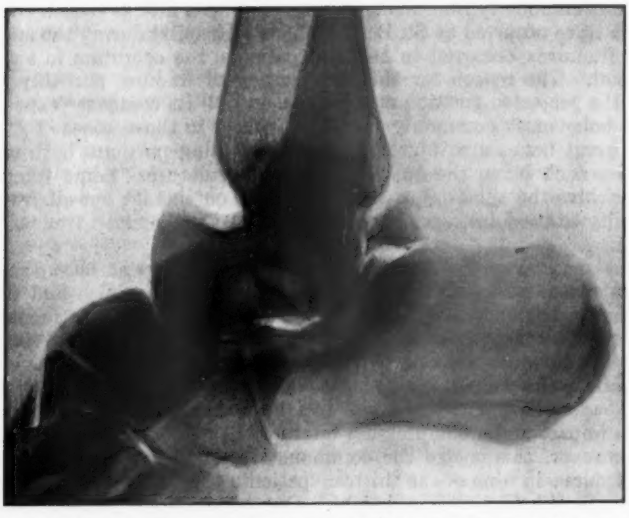

FIG. 3.—Fracture of posterior process of astragalus, with a subastragaloid dislocation.

fracture of the neck (fig. 1) of the bone when a patient falls from a height is apparently as follows:—

With the ankle dorsiflexed, a severe impact on the hind part of the foot causes the neck of the astragalus to become nipped between the anterior lower margin of

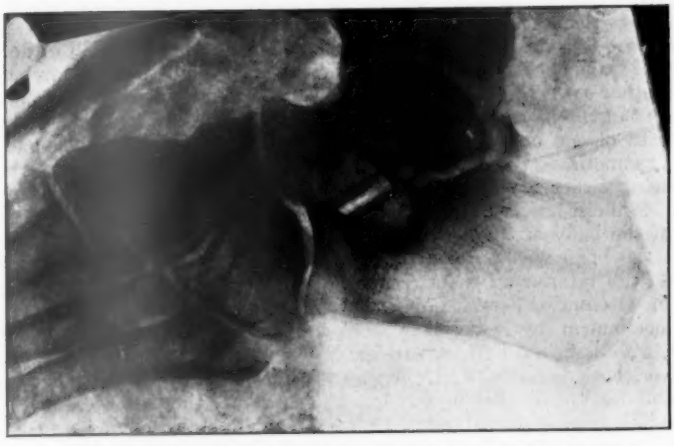

FIG. 4.—Same case as fig. 3 in plaster after reduction of dislocation.

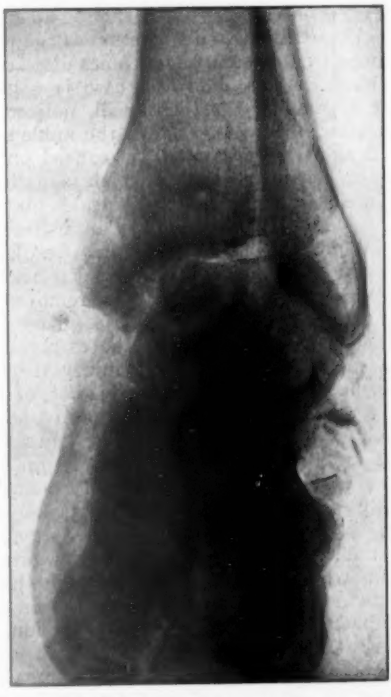

FIG. 5.—Chip fractures of outer side of astragalus.

the tibia above and the os calcis below, and being a weak part of the bone it fractures more or less vertically.

If the force is considerable and is continued, with the foot still in dorsiflexion, the posterior fragment is forced backwards and may come to lie behind the ankle-joint. In other cases the neck of the bone is fractured in association with an inward displacement of the foot, and the head, in relation to the body, is displaced medially.

Fractures of the body are usually due to a compression of the bone and are irregular; sometimes the bone is fractured into only two fragments, the line of fracture being either vertical or oblique, but more frequently the fracture is comminuted. Skillern has described a bony block of the ankle occurring as a result of a fracture of the body of the astragalus—it occurred with a vertical fracture of the middle of the bone with slight depression of the posterior fragment, thus causing a bony block, the anterior fragment coming up against the anterior articular margin of the tibia on attempting dorsiflexion.

The mechanism by which the posterior process is fractured is uncertain. Shepherd, who described this fracture in 1882, carried out numerous experiments in the cadaver, both inverting and everting the foot forcibly and also forcing it into plantar- and dorsiflexion, but he was unable to produce the fracture.

It is unlikely that the fracture results from direct violence, because it is in a very protected position. The posterior fasciculus of the external lateral ligament of the ankle, running from the external malleolus to the posterior process of the astragalus, may tear it off when the foot is suddenly forced into some unusual position. It is possible that the posterior process may be broken off when the foot is forced into plantar-flexion as a result of its hitting up against the posterior lip of the articular surface of the tibia. Often a fracture of the posterior process causes no serious symptoms, though occasionally it becomes displaced in such a way as to cause pain by a bony block. The following case is a good example of this: A medical student, after a game of Rugby football, noticed that his left ankle felt weak and was rather painful; a few days later, the ankle still causing trouble, he was examined and on full plantar-flexion pain was caused on the inner side of the ankle. A swelling, bony in consistency, could be felt behind the internal malleolus, and this appeared to be in connection with the astragalus on movement and to come up against the posterior aspect of the tibia on full plantar-flexion. Skiagrams showed a fracture of the posterior process of the astragalus (fig. 6), and a postero-superior oblique view (fig. 7) showed that the fragment was displaced to the medial aspect behind the internal malleolus. The fragment was removed at operation, and the function of the ankle is now normal and painless.

Diagnosis.—In a severe case a fracture of the astragalus presents symptoms similar to a Pott's fracture in that following an injury there is swelling and great pain on weight-bearing or flexion of the foot; there is not, of course, the eversion or backward displacement of the foot as in a Pott's fracture. Deformity, however, in a recent case before much swelling has occurred, may be seen in a filling up of the hollows on either side of the tendo Achillis, if there has been a backward displacement of the posterior fragment in a fracture of the neck or body of the bone. In some cases, especially those of fracture of the posterior process or in chip fractures, the diagnosis is usually only made by X-rays. A warning against mistaking an os trigonum for a fracture of the posterior process should hardly be necessary; it is so well known. In the case of a man who has fallen from a height and has swelling and pain in his ankle, if crepitus is felt on attempting movements of the joint and the malleoli are not tender on compression, then the diagnosis of fracture of the astragalus is strongly suggested.

Treatment.—For a fracture of the neck of the astragalus where there is no displacement, the foot should be immobilized in a plaster cast well moulded to support the longitudinal arch. A considerable strain comes on the neck of the

astragalus, so that weight-bearing in the case of an adult should not be allowed before from eight to ten weeks. In those cases in which the head of the astragalus is displaced medially with the foot, reduction by manipulation must be carried out and

FIG. 6.—Fracture of posterior process of astragalus with medial displacement of fragment as shown in fig. 7.

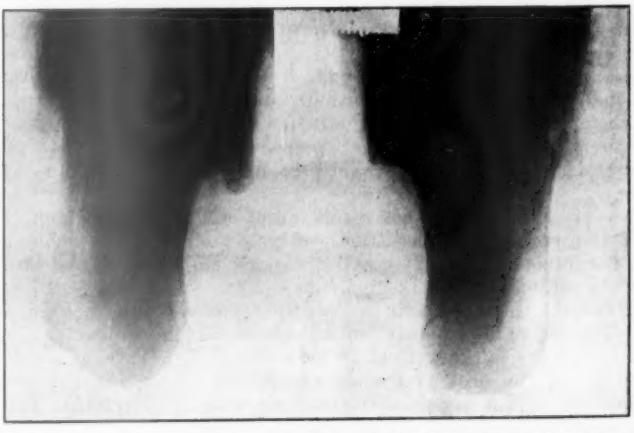

FIG. 7.—Postero-superior oblique view of same case as fig. 6, showing medial displacement of fragment.

the foot immobilized in plaster. Fracture of the neck with an associated backward displacement of the posterior fragment often presents a difficulty. An attempt should be made to reduce the fracture—the tendo Achillis must be relaxed as far as

possible by fully flexing the knee, then while pulling firmly on the foot to open up as far as possible the space between the tibia and the os calcis, an attempt must be made to replace the backwardly displaced fragment by pressing it forward with the thumb. If it cannot be reduced by manipulative methods, an open operation must be performed, because the function in unreduced cases is very bad. It may be possible to replace it at operation, but it is often found necessary to remove it.

Fractures of the body of the astragalus are usually irregularly comminuted, and each case has to be judged on its merits. Sometimes it is necessary to perform an astragalectomy, but this does not give a very good foot, and provided the alignment of the foot and ankle is fairly good, it is usually best to immobilize the foot in plaster and commence early massage and movements. A stiff ankle may generally be expected.

In fractures of the posterior process where a painful bony block arises, the fragment must be removed. When a subastragaloid dislocation (fig. 3) is associated with a fracture of the astragalus, the dislocation must be reduced and the foot immobilized in plaster. When there is arthritis and persistent pain, with limited movement in the ankle-joint, following a fracture of the body of the astragalus, an arthrodesis of the joint should be performed. Similarly when there is painful limited movement in the joint between the os calcis and astragalus, a subastragaloid arthrodesis should be performed. Amputation is necessary when the astragalus is pulped and the fracture open.

Actually, taking all fractures of the astragalus together, a considerable number require operation. Of the fifteen fractures previously referred to, seven were treated by immobilization either with or without a previous manipulation; in five instances some local operation was carried out, and in three cases amputation was performed. Conservative treatment, seven; removal of part of astragalus, three; complete astragalectomy, one; cuneiform tarsectomy, one; amputation, three.

Stalig, who collected 122 cases of fracture of the astragalus, found that in fifty of them an operation was performed for removal of some portion of the bone, and in eight an amputation was performed. In most of the cases the mobility of the ankle-joint was permanently impaired.

Prognosis and results.—It is difficult, from so few cases as fifteen, to assess accurately the prognosis and end-results of fractures of the astragalus, but I have tabulated them as follows: Perfect function, two; good ankle movements, but limited inversion and eversion, four; persistent stiffness and pain sufficient to disable the patient to a greater or less degree, four; amputated, three; patients lost sight of, two.

The two cases with a perfect result were: (1) That in which there was a fracture of the posterior process, with displacement and disability, and finally removal of the fragment, and (2) that in which some fragments of bone had been chipped off the astragalus without involving a joint.

It may be said, therefore, that in the majority of cases there is some permanent disability. The degree of disability depends on which joint is involved, whether it is the ankle-joint, or the subastragaloid, or both.

In fractures of the neck of the astragalus, the ankle-joint may or may not be involved, but even if it is, provided the fracture is not comminuted, a full range of movement may be obtained. This does not seem, however, to apply to the subastragaloid joint, the movements here being limited and sometimes painful. Thus, though the patient has a full range of flexion and extension at the ankle-joint, the movements of inversion and eversion are limited or perhaps absent. This will manifest itself when the patient is walking on rough ground or on the side of a hill. One patient is now able to walk twenty miles on the level without feeling tired, but a short distance along a hillside makes his ankle ache. Another patient works as a

signalman, and can walk eight miles, but he volunteered the statement that he "could not walk much on rough ground."

In fractures of the body of the astragalus the prognosis is worse, because the ankle-joint is usually badly involved; considerable limitation of movement is permanent and pain is also present in most cases.

The prognosis and end-results depend to a certain extent on the treatment carried out, but it is difficult to say either from this small series or from the literature, what operative treatment is likely to give the best results in severe fractures of the body of the astragalus; Gayet's figures seem to suggest that complete astragalectomy is likely to give better results than removal of part of the bone.

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Mr. E. P. Brockman: My contribution to this discussion is confined to two points:—

(1) The correction of an inverted foot, following a separated epiphysis of the lower end of the tibia, in which early union has taken place.

(2) The treatment of a chronic arthritis of the ankle-joint after injury.

The usual treatment for the first of these two conditions consists of an osteotomy of the tibia with removal of a portion of the fibula to enable the foot to be made plantigrade. It is unsatisfactory, in that growth continues at the lower epiphysis of the fibula and the deformity of the foot recurs within a few months. To get over this difficulty I would suggest that, besides performing an osteotomy of the tibia, the growth disc at the lower end of the fibula should be removed, thus preventing any further growth at this end of the bone. This has been carried out with success in a boy, aged 14, who had a gross deformity of the foot. After about eighteen months there is no sign of a relapse.

Unreduced Pott's fractures or other injuries of the ankle-joint are very often followed by a painful chronic arthritis, which is seldom relieved by physical treatment and completely cripples the patient, who is in pain whenever weight is borne on the limb and whose sleep is not infrequently disturbed by a constant ache. I would advocate that an arthrodesis of the ankle-joint should be carried out as soon as pain becomes constant. It will enable many a patient, in a few months, to return to even the most heavy work. Loss of movement in the ankle-joint gives very little disability, and the patients are uniformly grateful.

Out of twelve cases in which this operation has been carried out nine patients have been traced and examined. They were all free from pain, were doing full work, and had developed an increased range of movement at the mid-tarsal and other joints of the foot, which compensated for the loss of flexion and extension at the ankle.

There are one or two details of the operation and after-treatment which make for success. An antero-lateral incision over the joint gives the best approach. When the joint has been exposed, an oblique osteotomy of the fibula with downward displacement of the external malleolus enables the arthrodesis to be carried out without difficulty. After the cartilage has been removed from the joint surfaces, the lower end of the fibula should be pegged down to the tibia. It helps to hold the joint surfaces in contact and makes for ease whilst the plaster is applied. A fortnight after operation, without an anæsthetic, the stitches can be removed and a close fitting plaster applied. Twenty-four hours later, the patient can begin walking, bearing

weight on the limb. Within three months the patient should be able to walk, free from pain, wearing an ordinary shoe, and within about four months to return to work.

The President said that when he opened a discussion on ankle fractures at the British Orthopædic Association meeting in 1925, the method of treatment used in his clinic at that time was manipulative reduction, plaster fixation, and comparatively late weight-bearings—i.e., from the sixth to the tenth week. All patients passed through the physio-therapeutic department.

During the period 1926-1929 his clinic was under the potent influence of the Delbet plaster, used not merely as an ambulatory splint, but as a method of primary fixation. With this was combined early weight-bearing. He was absolutely convinced that early weight-bearing, whether in the Delbet or other form of ambulatory plaster, determined an earlier return of full working capacity. In patients treated with early weight-bearing no form of physio-therapy is required. There is a marked absence of œdema, the ankle-joint is often completely mobile after six weeks, and many patients at the end of that time are able to walk without any fixation apparatus.

During the last two or three years, in his (the President's) clinic, the Delbet plaster had been used sparingly, largely on the grounds of expense. At the present time the Böhler routine was in vogue, viz., a "skin-tight" complete plaster enclosing the whole foot, allowing the patient to walk, after the subsidence of the swelling, on a stirrup or a plaster heel.

He exhibited on the screen a series of slides illustrating the effectiveness of the Delbet plaster as a method of primary fixation in complete fracture dislocations of the ankle (Pott-Dupuytren type). The slides also illustrated the important principle that the manipulative reduction of fracture-dislocations of the ankle could be followed by the restoration of perfect working capacity. His experience had been that fractures with gross displacement locked into position after reduction, that there was little tendency to re-displacement, and that either the Delbet or the ordinary complete plaster gave perfect control. He saw no place for the open reduction of these fractures in the first forty-eight hours after the injury. It might be necessary of course to operate in a neglected fracture some days old, when the astragalus could not be completely replaced, or did not remain in position. The compound fracture was a problem *sui generis*.

In conclusion he wished to support the view that the early ambulatory treatment of ankle-joint fractures was the best method of restoring the patient to full functional activity at an early date.

Mr. George Perkins said that ten years ago in a very fine paper published in America, Ashhurst had divided fractures of the lower end of the tibia and fibula involving the ankle-joint into four types, depending on the direction of the trauma.

He submitted that Ashhurst's classification was better than that advocated by Mr. Broomhead, because in all four types the ease of reduction, the ease of maintaining reduction and the prognosis, were different.

Type 1.—*The external rotation fracture*, the most frequent, followed an external rotation force applied to the foot, which caused a spiral fracture through the lower inch of the fibula, with a fracture of the internal malleolus or a rupture of the internal lateral ligament. Reduction was easy: if traction and internal rotation were applied to the foot the fragments snapped back into position. Once reduced there was no tendency for the deformity to recur. Any form of splint was adequate. And the prognosis was excellent.

Type 2.—*The abduction fracture*, the next commonest, followed an abduction force applied to the foot, which caused a transverse fracture of the fibula three inches up,

with a fracture of the internal malleolus or a rupture of the internal lateral ligament. Reduction was not so simple: the foot must be forcibly adducted to correct the valgus deformity at the ankle-joint. Even when reduced, there was a tendency for displacement to recur, and a well-moulded plaster splint was essential. After removal of the plaster at the end of six weeks, there was still a tendency for the fibula to bend at the site of fracture and to cause a secondary malunion, so that protection by an inverting T-strap and an outside iron was necessary for six months from the date of fracture. In both types (1) and (2) there might be in addition a fracture of the posterior margin of the tibia with backward displacement of the foot.

Type 3.—*The adduction fracture* followed an adduction force applied to the foot which caused an oblique fracture of the lower end of the tibia, running into the centre of the mortice below and extending upwards and medially. There was often, in addition, a fracture of the tip of the external malleolus. Reduction was not easy, and the tibia fragment often required internal fixation to hold it in place. Once reduced, there was no tendency for recurrence of the deformity after six weeks in plaster.

Type 4.—*The T-shaped fracture into the joint* followed an upward thrust on the under surface of the foot, which caused a comminuted fracture of the tibial platform. Accurate reduction was most difficult, even with internal fixation of the various fragments. Owing to damage to the mortice a painful ankle frequently followed and subsequent arthrodesis became necessary.

Ashurst's classification enabled Type 1 (the external rotation fracture) to be distinguished from Type 2 (the abduction fracture). Both types were commonly grouped together in this country as "Pott's fracture"; but in his, the speaker's, opinion it was essential to distinguish them, as the one was so easy to treat and gave the surgeon so little trouble, whereas the other was difficult to treat and was often less satisfactory to both surgeon and patient.

Mr. N. L. Capener said that a late result of a certain type of fracture of the astragalus was worth mentioning. Eighteen months ago he had seen a boy who had compressive changes in the body of the astragalus after an injury which had occurred some months previously. It was similar to a case reported by Phemister last year, in which there was evidence of fracture of the neck of the astragalus, with interference with the blood-supply of the body of the astragalus, followed by aseptic necrosis and compression.

Mr. St. J. D. Buxton said that Mr. Perkins' classification was less convincing than Mr. Broomhead's. As the commonest fracture was that of the fibula, without displacement, it was important to lay special stress on its treatment. Mr. Broomhead apparently gave no support to legs with this fracture. Such a policy he, the speaker, regarded as dangerous, particularly in a heavy woman. He would like to see such legs supported for from six to eight weeks. It was his custom, in cases of fracture of whatever kind, to give support to the limb for a period longer than Mr. Broomhead allowed.

The Delbet was never used very much at King's College Hospital, the complete plaster was employed. The first important point was that the reduction should be complete. The second important point was fixation in an apparatus to hold the limb reduced. He stressed the need of proper fixation. It had been the custom at his hospital to put on a thick plaster foot below, or a wooden sole plate. Since seeing Böhler, he had used a metal stirrup; the advantage was that patients could walk without crutches.

A difficult question was when the plaster could be left off. If there had been a displacement which was perfectly reduced, he (Mr. Buxton) kept on the plaster

eight weeks; if there had been a gross displacement with a slight error of reduction, he kept it on nine or ten weeks. If there was a difficulty in moulding the plaster after reduction, i.e., if the fracture tended to slip—particularly in the third degree which Mr. Broomhead had mentioned—it was a help to put a plaster slab on to the back of the leg and up the sole of the foot, holding the foot at a right angle with the leg, and allowing that to set before the rest of the plaster was applied.

The difficulty of the subsequent swelling confronted all surgeons. His impression was that in a number of cases the feet would swell whatever the treatment, and whether the patient lay in bed or had an ambulatory plaster. Every foot swelled for a time when the plaster came off, but many patients recovered from this quickly. If there was swelling for four or five weeks after removing the plaster, he put on an elastoplast bandage. He did not think that massage and physical treatment were of much advantage if the patient was walking about with a swollen foot.

Mr. Donald Barlow said that he had used the Delbet plaster for some years, and thought it the most valuable treatment possible in these cases, or at least the best at present known.

The plaster was simple, it could be used by any general practitioner who was able to watch the case in order to see that the swelling which occurred in the first few days should not be too extensive. It allowed the foot to be dorsiflexed early, and permitted early ambulatory treatment, so that the return of the patient to business was hastened. Crutches were practically never necessary, indeed they were a disadvantage, as, with crutches, the axilla bore the pressure instead of the foot, whereas the latter should be used early. But the plaster must fit the patient accurately, being carefully moulded to the whole limb, and avoiding pressure on the crest of the tibia, both malleoli, and the common peroneal nerve; on one occasion he had found that nerve paralysed following a badly-moulded plaster.

Another point concerning the accurate fitting of the plaster was, that it acted as a self-massaging apparatus. Massage was superfluous if the plaster fitted accurately. He had covered the limb with stockinette before applying the plaster, as it was not necessary to apply the latter direct to the skin.

He thought there was less tendency to osteo-arthritis if the patient was soon allowed to walk. He kept the Delbet plaster on for from six weeks to two months, the time depending on the severity of the fracture. Where there had been severe abduction dislocation, or an adduction fracture, he splayed out the side pieces of the Delbet plaster beneath the foot so that they held the foot in good position, preventing abduction or adduction.

The criterion he used as to whether these fractures were in good position was that the astragalo-tibial articulation must be horizontal.

He had had but little experience of local anæsthesia in the reduction of fractures, but one point which had been overlooked was, that by using a needle for a local anæsthetic one converted a simple fracture into a compound fracture.

For compound fractures of the ankle-joint there was another treatment—Orr's. In one case of compound fracture of the ankle-joint, the patient was taken to the theatre as an emergency case; the wounded area was excised, the region packed with flavine and vaseline and plaster applied. An uninterrupted convalescence ensued.

Mr. Naughton Dunn said that if the internal malleolus was not fractured there was little difficulty in treating any case of fracture in the neighbourhood of the ankle-joint.

If the internal malleolus was not fractured the essentials of treatment were to

ensure dorsiflexion of the foot and inversion. Considerable force was sometimes necessary to effect reduction when the posterior portion of the tibia was fractured. Following reduction this position should be maintained in plaster for from eight to ten weeks. The tendency in many cases was to allow freedom too early.

Mr. Broomhead had mentioned the question of plating certain fractures in the neighbourhood of the ankle-joint. In cases in which the internal malleolus was also fractured so that there was no fixed point from which to stabilize the reduction, the foot must be put up in the medium position. The result then would probably be better than after a difficult and big operation of plating fractures of several bones in the neighbourhood of the ankle.

It must however be realized that whether reduction was complete or incomplete, one would, in a certain percentage of cases, encounter a traumatic arthritis in a joint which had been subjected to severe injury. This would lead to persistent pain in the ankle-joint, in which case arthrodesis offered the best result.

Mr. W. Rowley Bristow said there was no doubt that Ashurst's classification of fractures had carried us further than did the classification laid down by Arbuthnot Lane. He agreed with those who had said that reduction was essential. In the first type, the rotation fracture, reduction was simple, and he (Mr. Bristow) submitted that so long as one reduced that fracture, it would not matter what form of splintage was used; the result was bound to be good.

The second type which Ashurst described, the abduction fracture, was equally easy to reduce. The difficulty was to keep it reduced. This fracture needed to be kept fixed a long time, and when the plaster was removed it was necessary to protect it from strain, by a raising of the heel on the inner side, an outer steel and an inside T-strap.

He agreed with Mr. Broomhead and Mr. Brockman on the treatment of painful ankle following fracture. They had all been shown and were familiar with the various elaborate operations for reconstruction of malunited fractures of the ankle, but he believed that all surgeons of experience were now agreed that arthrodesis for a painful ankle following malunion was the correct treatment.

Members would do well to consider Ashurst's classification from the point of view of the prognosis and treatment of these fractures.

Mr. Broomhead (in reply) said that the discussion seemed to have centred chiefly round the ambulatory, *versus* the recumbent, treatment of these fractures, and as to the best method of attaining and maintaining reduction. There was, he submitted, no real argument, because if the fracture was properly reduced no matter what splint was applied, it would remain in position.

External rotation fractures were the easiest to reduce. Mr. Buxton had remarked that most cases were external rotation fractures of the first degree. In his (the speaker's) practice, however, there was an almost equal number of all degrees of abduction fracture.

The demand for hospital beds was a factor in deciding what form of treatment to adopt. That largely accounted for the use of the Delbet plaster. Patients who had the Böhler plaster walked easily on the stirrup, and they did not seem so difficult to stimulate to walk as were those fixed in a Delbet plaster.

One speaker had said that the Delbet plaster could be used by the ordinary practitioner, but that was not his, Mr. Broomhead's opinion; it needed great care in applying, as Members who recalled their own first attempts would agree.

He agreed with Mr. Naughton Dunn that very few of these cases required operative treatment.

[*April 5*, 1932.]

Myeloma of Tendon Sheath.—E. HENRIETTA JEBENS, F.R.C.S.

Mrs. M. O., aged 49.

History.—Early in August, 1931, patient noticed a small swelling (about the size of a pea) on the flexor surface of the second phalanx of the fifth finger of her left hand. She states very definitely that there had been no injury. The tumour was then quite soft and mobile. As a skiagram of the finger taken on August 14 showed no abnormality of the bone and the little tumour did not worry or inconvenience the patient, nothing further was done. The tumour, however, increased in size and became harder, and in January, 1932, began to ache and cause disability. Patient was sent to me on January 21.

On examination.—There was a tumour the size of a gooseberry extending over both the flexor and extensor aspects of the middle phalanx of the fifth finger of the left hand. The skin was tightly stretched over the swelling, so that it was

impossible to say whether the tumour was attached to the skin or not. The tumour was definitely lobulated, smooth and of elastic consistency—in fact I thought it was fluctuant. The movements of the interphalangeal joints were free and painless, though full flexion was limited, owing to mechanical obstruction by the swelling. There was marked tenderness over the lobule of the tumour situated on the ulnar aspect near the distal interphalangeal joint.

Treatment.—I attempted to aspirate, but as the attempt was unsuccessful, I removed the tumour by operation on February 9, 1932.

Operative findings.—The swelling consisted of five rounded, well encapsuled, pale yellow masses, which shelled out readily and appeared to be loosely attached to the periosteum. The tumour surrounded the flexor and extensor tendons, no sheaths being visible. It was not attached to the skin.

Microscopic examination showed it to be a myeloma.

Comment.—Referring to the literature on tumours connected with tendon sheaths I find that the described cases fall into two groups: (1) A small group of definitely malignant tumours; (2) a large group of tumours—usually termed myeloma—which all share certain characteristics. They are slow-growing, do not infiltrate, do not give rise to metastases, and, if completely removed, do not recur locally. They are all encapsuled, lobulated tumours of elastic consistency and yellow—often bright yellow—in colour, with small petechiæ. Microscopically they show numerous giant cells in a cellular tissue with well-marked strands of fibrous tissue and thick-walled blood-vessels.

The nature of these tumours is still obscure. Fleissig, in 1913, put forward the view that they are inflammatory in origin, basing his contention on the presence of cholesterin crystals and lipoid, the absence of mitoses, and the foreign-body type of giant cell, together with the slow growth and benign course of the lesion. This view is upheld by A. C. Borders in his paper on seventeen cases treated in the Mayo Clinic. He emphasizes, in support of this theory, the frequent occurrence of trauma and states that old hæmorrhage is one of the constant findings. Ewing agrees with this view.

The other theory is that the swelling is a true neoplasm. Heurtaux regards it as a new growth, but of an innocent nature and not a sarcoma. He refers to the tumour as a myeloma. Bellamy thinks these swellings are neoplastic, but should be regarded not as myelomas, i.e., bone-marrow tumours, but as endotheliomas, as he found active proliferation of the endothelium of the blood-vessels. Stewart and Flint likewise reject the theory of the granulomatous nature, as a sharply-defined, lobulated and encapsulated tumour is rarely, if ever, seen in inflammatory formations, and also inflammatory cells of the ordinary type are entirely absent. Cholesterin and lipoid are also found in neoplasms and do not constitute proof of inflammatory origin. I agree with these authors, for in my patient I could find no suggestion of inflammatory origin, and there was no history of trauma.

In my case the tumour appears to belong to the innocent group, though it varies from the usual description in two particulars: (1) the rate of growth was comparatively rapid. Bellamy states that "to equal the size of an almond requires five or six years." My patient's tumour reached the size of a gooseberry in six months. The average duration of cases at the Mayo Clinic is given as seven and a half years. Heurtaux gives the average duration as seven years. (2) The characteristic deep yellow colour and petechiæ were absent in my case. The tumour that I removed was pale yellow, rather like a lipoma, and homogeneous.

The attachment to periosteum suggests that the tumour may really spring from that structure. The giant cells being osteoclasts, the whole structure suggests similarity with epulis. It is difficult to see how marrow-cells could be found outside the unbroken periosteum—unless the embryonic rest theory be invoked—and, in my opinion, the growth is most unlikely to be a product of the bone-marrow.

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Traumatic Dislocation of the Hip in a Child, aged 7, with Subsequent Development of Coxa Plana.—R. C. ELMSLIE, M.S.

J. B., a girl, aged 7, came to St. Bartholomew's Hospital, March 17, 1932.

History.—In July, 1931, she had been caught in an elevator on the hayfield and thrown over a rod, and the left hip was dislocated. The dislocation was reduced in Brentwood Hospital by Gibson one week later. She remained three weeks in hospital. Was all right afterwards until five weeks ago when she began to limp

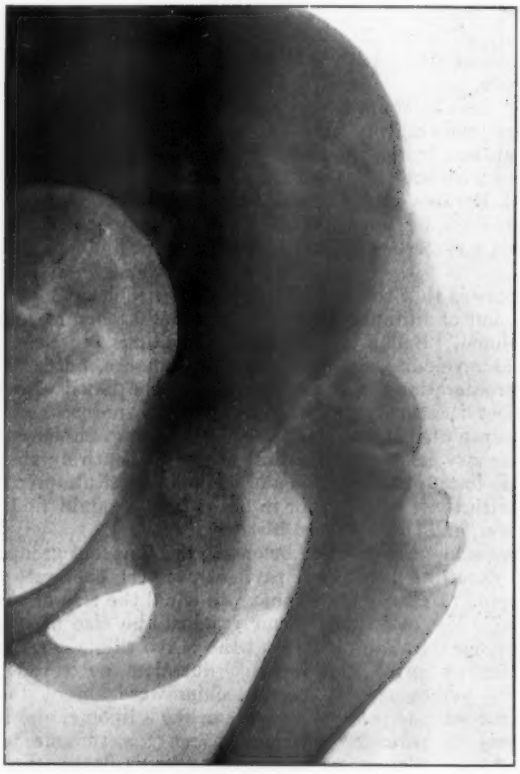

FIG. 1.

with the left leg. She had some pain in the left thigh, and the leg was noticed to be a little thinner.

Present condition.—The left lower limb is a little wasted. Abduction of the left hip is practically abolished, and there is very little rotation.

A skiagram taken at the time of the accident shows posterior dislocation of the hip (fig. 1). A second skiagram (July 14, 1931) shows the hip reduced, and no

abnormality is evident. Third skiagram (March, 1932).—The epiphysis of the head of the left femur is thin, spread out at the margins. Density slightly increased. Typical early coxa plana (fig. 2).

This case is exactly parallel with one which I have shown at a previous meeting of this Section.[1] There is one other case of the same sort on record. I believe that the lesion in these cases is an injury of the ligamentum teres and a consequent interference with the vascular supply of the nucleus of the head of the femur. I am aware that anatomists have denied that any blood-supply to the head of the femur is carried through the ligamentum teres. This may be true later in life, but

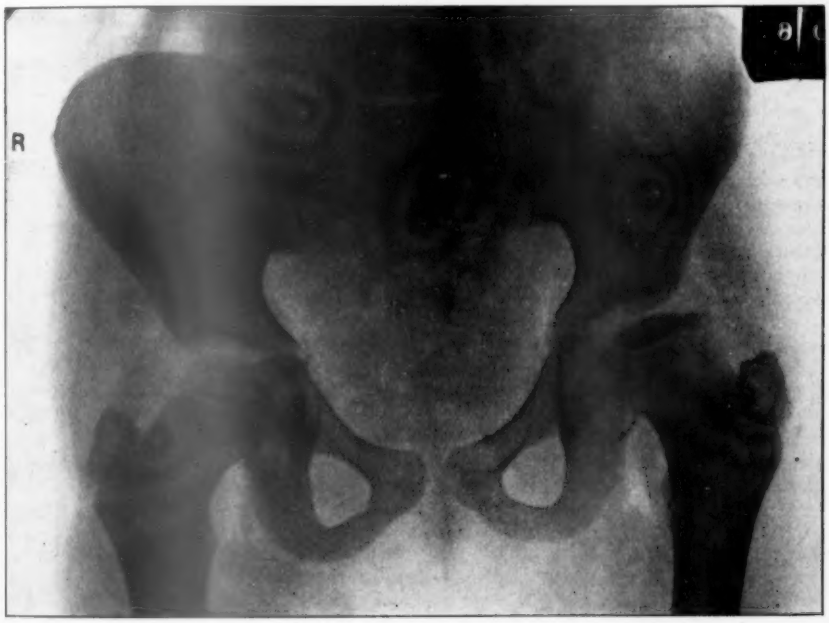

FIG. 2.

there is no doubt that the original vascularization of the epiphysis of the head takes place through the ligamentum teres and that the artery in this ligament is an important source of blood-supply in the early years of life. I believe that coxa plana is essentially a nutritional disorder, and that the characteristic type seen between the ages of 4 years and 8 or 9 years, is associated with an interference with a proper supply of blood to the epiphysis of the head of the femur.

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The following cases were also shown:—

(1) **Fractured Dislocation of the Cervical Spine, with Skiagrams taken before and after Reduction of Displacement.**—W. H. OGILVIE, M.Ch.

1 *Proceedings*, 1922, vol. xvi (Sect. Surg., Sub-Sect. Orthop., 47).

(2) **Successful Athroplasties in Old Case of Still's Disease.**—H. S. SEDDON, F.R.C.S.

(3) **Chondroma of Tendon Sheath: Specimen.**—ST. J. D. BUXTON, F.R.C.S.

(4) **Two Old Cases of Dislocated Semi-lunar, reduced by Manipulation after the use of Skeletal Traction.**—C. R. BOLAND, F.R.C.S.I.

Section of Neurology.

President—Dr. A. Stanley Barnes.

[*February* 18, 1932.]

The Phenomena of Regeneration in Peripheral Nerves after Suture.

By J. le Fleming Burrow, M.R.C.P.

General Considerations.

The chief basis for this paper consists of special clinical records compiled from October, 1914, to September, 1915, and again from early in 1917 to the present time, during the routine examination of men suffering from war injuries of peripheral and central nervous structures. Out of 2,000 individual case records there are 359 cases of secondary suture of peripheral nerves.

Most of the injuries were caused by gunshot wounds and were associated with early septic infections, so that nerve suture was often impossible for a long time, and when performed, was hampered by the inevitable changes which had resulted from sepsis, often much loss of tissue, and subsequent repair by vascular or dense fibrous tissue. It will be realized at once that repair of peripheral nerves, and the recovery of function which followed, must have been very much easier and more complete in other circumstances, such as obtain in primary suture in a clean wound, where there is no loss of nerve substance. In any discussion of the results, the estimation of the time taken for recovery, and the consideration of the phenomena of regeneration, these surgical difficulties must be borne in mind. It would be unfair to compare the rate of recovery and the final results with those which follow a primary nerve suture in a healthy healing wound.

It is quite allowable, I think, to utilize a unique opportunity provided by the war for the study of phenomena which arise in the regeneration period after nerve repair. The great value of the war cases is that they provide so many varieties of nerve injury, often multiple in the same limb, so that "overlap" areas can be estimated and some interesting facts concerning deep sensation come to light. One great disadvantage of the war injury case is that the damage is so often extensive, muscles, tendons and blood-vessels being involved as well as the nerves. The experiment is never an exact one, and the resulting phenomena in the recovery period cannot unhesitatingly be ascribed to the damage and restoration of a single structure. It would therefore be unprofitable to discuss the rate of regeneration after suture, except in very approximate and general terms.

The individual factors of sepsis, fibrosis, loss of main arteries, &c., all interfere with the formation of accurate estimates of the recovery rate in war-injured limbs.

I propose to take a few selected records as examples and start from the zero of complete division. We shall then follow the phenomena of regeneration clinically by making re-examinations, until the seemingly final, but still imperfect, recovery is made.

I have formed the opinion that perfect restoration of all the functions subserved by a mixed nerve and its peripheral endings never happens after nerve suture.

I propose to omit discussion of current theories, because it is desirable to make this paper a record of personal experience.

Methods of Examination.

Routine work made it impossible to treat the cases as individual research records, though a few were selected for special study. The technique for making the observations was simplified as much as possible, but was standardized so that the results

of successive examinations were comparable. Such details as room temperature, and the temperature of the limbs (which sometimes were warmed to a constant temperature in a paraffin wax bath) we found most important. Physiological stimuli were used as far as possible (the details of our technique were published by Dr. Carter and myself in our first thousand cases, 1918 to 1919).

For light touch, "moving contact," we used a camel-hair brush with all its hairs except four removed; this formed a routine preliminary test for light touch on the skin. Single human hairs were used for more exact work. To obtain a standard "pin-prick" stimulus we used the spring algesiometer of Head and Holmes. For readings of pressure the algometer was put into use in special cases which were being closely investigated. Heat and cold were tested by means of a copper cylinder, to one end of which was fitted a one-millimetre square contact. The top of the cylinder was open so that hot water or ice could be used, and the cork at the top could be replaced with its thermometer. For muscle testing, we gave up our efforts to obtain exact readings by means of condenser discharges and the Keith Lucas spring contact breaker, and we returned to the ordinary faradic coil and constant current with a make-and-break key operated by hand. We found that the variable skin resistance made all attempts at exact electrical readings impossible of attainment.

Motor Recovery.—For the sake of brevity I propose to discuss this subject in a few words and to omit all mention of the various electrical phenomena observed, etc.

It was found that usually the proximal muscles recovered first and that motor nerve fibres seemed to find their way down to the distal muscles last of all. Marked inco-ordination was very commonly noticed in the recovery period, and much re-education of the muscles was essential to obtain the best functional results.

Sensory Recovery.—The phenomena of sensory recovery I wish to introduce now by showing a typical record of a case.

W. J. C., aged 25, shrapnel wounds, 17.1.17, in the back of the right thigh and in the lower part of the right forearm.

Admitted to Second Northern General Hospital at Leeds, 20.4.17.

When examined, May 2, 1917, he was found to have a complete paralysis of the right sciatic nerve and also of the right ulnar nerve above the wrist, so that all the muscles below the knee were paralysed, and all the ulnar muscles of the hand.

Mr. A. Richardson sutured both nerves on July 25, 1917; the sciatic was sutured after resection of fibrous bulbs from both the internal and external popliteal divisions. The ulnar nerve was exposed two inches above the wrist and one and a half inches of fibrous nerve removed before the ends were sutured.

Examined 18.1.18 (177 days after nerve suture), when some very early signs of recovery were noted. There was still the full area of loss to light touch in the ulnar area of the hand; the pin-prick area and qualitative sensory changes were as before. There was loss of sensation to deep pressure over all the phalanges on the dorsum of the hand, but on the palmar aspect the loss was limited to the terminal phalanx and the pulp of the little finger. There was complete loss of joint sensation in the interphalangeal joints of the little finger. Pressure over the metacarpal area, however, elicited a tingling sensation which was referred to the finger below. The earliest sign of recovery in the peripheral part was found to consist of a gradual diminution of the area of loss to deep pressure, the area first responding with a sensation as of a "deep bruise," then with a more diffuse tingling sensation which was referred usually towards the distal part of the still anæsthetic area to light touch and other skin stimulation.

This case is typical of many in our series. On re-examination 246 days after repair of the ulnar nerve some motor power was noted in the adductor pollicis and the flexor brevis pollicis; there was still a nearly full area of loss to light touch, but with deeper stimulation the whole area responded by radiating, tingling, and ill-localized sensations, except over the ulnar side of the ring finger where loss to light touch persisted unchanged; no tingling sensation was felt in this area.

Cold spots were found, but appeared to respond with a sensation of tingling rather than with a true appreciation of cold; the sensation evoked seemed to consist of a compound experience which the subject found difficult to analyse and express in words.

In 320 days there was appreciated over the whole ulnar area, except the dorsum of the little finger, a sensation when light touch was employed. Anything more than lightest touch caused the radiation and tingling reference sensations commonly called "protopathic" when stimuli were applied to the affected area.

On July 8, 1919, nearly two years after the ulnar suture, all the muscles were working strongly and were easily stimulated by faradic current. The sensory loss in the ulnar area was qualitative only when compared with the corresponding skin on the sound side.

The spring algesiometer set at eight was appreciated as "sharp," tactile discrimination was good, localization was good, joint sense nearly as good as that on the sound side, and there was a complete disappearance of the radiating, tingling sensations noted earlier, so long as the skin was warm. Shaving the skin on the back of the hand did not impair the sensation more than a little, and it did not alter the quality of the sensation as far as the patient could tell, except that light touch was even less "ticklish" over the shaved skin than it had been before, and in comparison with the sound side the affected side was always less "ticklish" than the skin on the intact limb. After chilling the skin superficially on a cold plate a return of the sensations of tingling and reference was noted. As the skin became warm again the normal sensation was restored. An experiment made on the sound side gave only a raised threshold for sensation without any of the abnormal tingling sensations experienced on the affected side.

After five years this case still remains in the same condition: a good functional result but with slightly impaired sensation—permanently, in all probability.

The sciatic nerve recovery was followed by a series of charts in the same manner to almost complete recovery, and the sensory changes were noted to be about the same in quality though recovery was necessarily a slower process.

In the case of the sciatic nerve, nearly two years were required for a functional result good enough to enable the man to walk well, but at this time the small muscles of the foot were still paralysed, and the foot was very defective in joint sensation; there were many tingling and reference sensations elicited on testing sensory function in the ordinary routine.

In a successful case in which a gap of three inches in the median nerve was bridged by a length of internal cutaneous nerve, progress was followed by motor and sensory charts. The operation was performed by Mr. Rowley Bristow at Shepherd's Bush Hospital, February 3, 1917, and the patient was subsequently sent home to attend at the Northern General Hospital at Leeds. A year after operation definite power was noted in the flexor muscles on the front of the forearm (carpi radialis, palmaris longus, pronator teres). The patient was re-examined in November, 1918, and from then onwards made a very good recovery. He was able to flex the terminal phalanx of his thumb and to use the small muscles on the ball of the thumb. The sensory recovery was not perfect when he was examined at the end of the summer of 1922. There was still loss of sensation to light touch in the distal parts of the median fingers, and there was very pronounced radiation, tingling, and reference sensation when deeper stimuli than lightest touch was used.

Conclusions.

A complete summary of all the phenomena encountered during the recovery period of peripheral nerves after suture is difficult and would be too discursive. Certain events only are emphasized here and are as follow:—

(1) The earliest sign of regeneration to appear *in the nerve trunk*, below the suture level, is elicited by gently tapping upon the nerve, when a tingling, diffuse, uncomfortable sensation is experienced by the patient. As regeneration proceeds this sign is obtained at progressively lower levels. It has been described as Tinel's sign because it was first described by J. Tinel in 1916 (Les Blessures des Nerfs, "fourmillement . . . traduit la présence de cylindraxes jeunes en voie de régéneration"). An arrest of the down-growth of new nerve fibres is associated with a stationary level at which Tinel's sign can be elicited. We found this sign of great value when following cases of nerve recovery, but it cannot be relied upon exclusively, nor ought it to be dissociated from the full clinical examination of the other motor and sensory functions of the affected nerve.

(2) The early peripheral changes after suture were usually marked by improvement in the trophic appearances in the skin and circulation of the affected part. Physiotherapy may also have some share in the improved state of the skin shown in these cases.

(3) Following closely upon improved trophic changes we have a return of some deep sensation. The patients described these feelings as like "a deep bruise" when firm pressure is made over the soft parts which were formerly anæsthetic to deep pressure. These sensations are earlier than the "tingle and reference" or "protopathic" sensations, and they are quite distinct in their quality as described by the patients. At this time the superficial parts are totally anæsthetic. This constitutes a return of deep pressure pain.

(4) The sensations next in order to appear were those radiating, tingling and uncomfortable feelings elicited when the skin and deeper tissues were pressed upon, pricked, or scraped. These sensations persisted for many months until cutaneous sensation was restored so that light touch could be felt. When these abnormal sensations seemed to have disappeared they would still reappear if the skin were cold, or were specially chilled for testing purposes.

(5) The true "protopathic" skin sensations were next to appear. These were evoked by touching the hairs, or by stimulation with light touch. The threshold was still higher than that required to obtain responses from normal skin of the corresponding limb on the opposite side of the body. Cold, hot, and pain spots now definitely reappeared, but all sensation was of an abnormal character as yet.

(6) The next function to return was discrimination of posture in the joints and muscles of the digits which have been affected. This function remains very defective for many months, but returns gradually after the deep sensations are found to have returned.

(7) Next there was true sensation to light touch by hairs moved along the surface of unshaved skin, and then, later, even when the skin was shaved free from the projecting hairs on the area under examination. This restored sensation was free from tingling sensations and still imperfect; the patients described it as "less ticklish" than the skin in the unaffected side which was used for comparison.

(8) Lastly, there was more complete recovery of sensation of superficial touch, moving contact, and hairs used in punctate fashion; discriminating sensibility—warm and cool areas—and joint sensation was more perfect.

Complete restoration has not been observed in any case, in the sense that the sensation experienced is the same as that on the unaffected areas of skin used for comparison.

Certain general features were observed during recovery. The proximal muscles almost invariably recovered before those distally placed. Some muscle bundles seemed to recover before others in the same muscle. Electrical changes were variable, and the anomalous results were evidently due to the transition from denervated to enervated muscle. The more easily excited nervous tissue, as it was restored, anticipated the less excitable muscle, so that the character of the responses was altered because of this recovery.

Anæsthetic areas on the skin seemed to diminish irregularly, but nearly always the more distal parts were the last to recover, as might be expected from the down growth of the nerve fibres. At the periphery three stages of recovery may be distinguished: (1) Deep sensation of pain to pressure without any feeling of radiation or reference, and without localization. The skin areas are devoid of sensation at this time. (2) In the skin, a stage of radiation, reference and tingling where painful and unpleasant sensations of an abnormal kind predominated in the skin and deeper tissues. ("Protopathic" of Head.) Hair-clad skin and the use of coarser stimuli emphasize these sensations. (3) Tactile sensation recovery, progressing to something short of perfection, but characterized by a diminution of the radiating.

tingling and reference sensations, and accompanying this is a restoration of discriminating sensibility in skin, joints and muscles.

Joint and muscle sensations seemed to be restored earlier when re-education exercises had been followed, so that all the delay in the reappearance of these functions cannot be ascribed to delayed regeneration of the nerves involved.

Observations upon thermal sensibility have been incomplete, owing to the difficulties encountered by thermal adaptability. Unless the skin was examined under ideal conditions, i.e., always at the same temperature, such varying results were obtained that we gave up the experiments as, owing to the press of routine work, the necessary time was not available.

Finally, as a result of my experience, I have formed the opinion that changes in the end-organs in the skin and deeper tissues hold the secrets of most of the phenomena encountered.

Differing, as they probably do, in their various recovery rates, some perhaps never being restored, and many connected after suture to heterogeneous pathways, we have a double source of error possible. If the distance receptors of our special senses can be specific in their selection of stimuli, why not the various end-organs on the surface of the skin?

Varying excitabilities and interference effects are possible at the periphery. Dissociation of sensation is possible in the skin. The experiences related and certain histological findings, as yet incomplete, lead to the view that these varied phenomena of regeneration in the sensory nerves may be explained more completely by a full study of the endings rather than by an assumption that certain classes of nerve fibres exist which would modify the conducting pathway in the nervous system.

Curare in Man.

By Ranyard West, M.D.

Introduction.—Since the classical experiments of Claude Bernard [1] and Kolliker [2] curare had been considered to produce its pharmacological action exclusively upon the end-plates of the motor nerves. When the chemistry of curare was subsequently undertaken (Boehm [3], Lewin [4], Spath, etc. [5]), the various active principles isolated were classified according to the presence or absence of their peripheral effects. It was considered unlikely that curare could have a useful place in medicine, in view of the undesirable nature of its action. Curare was indeed used in one or two desperate cases of hydrophobia and tetanus (Hunter [6]), when it was difficult to choose between paralysis and convulsions, but there appeared no place for it in normal therapeutics. It was not until the electrical properties of the nerve, nerve-ending and muscles came to be studied (Lucas [7]) that a differential action of this drug was discovered. Recently Bremer, Titeca and Van der Meiren in Brussels, and Hartridge and the author in London, recorded a selective removal of certain rigid conditions in the experimental animal. Bremer, Titeca and Van der Meiren [8, 9, 10, 11, 12] recorded a selective abolition of decerebrate rigidity and of local tetanus in the cat. Hartridge and the author [13] recorded a selective abolition of the tonic, clonic and fibrillary fits of dogs suffering from parathyroid tetany, and suggested a number of possible sites a lesion of which might produce this effect. What emerged from our work was that tetany in the dog could be abolished by a dose of curare which was only half of the minimum dose required to produce signs of paresis. A dog so treated would pass from the violent, continuous convulsions of tetany into an apparently normal state and would so remain for some hours.

At the time this work was undertaken, I was engaged in an investigation of the neurological mechanism involved in tetany, and the possible association of tetany with certain other diseases of the central nervous system suggested to me a trial of

curare in other conditions. The margin of dosage in the dog seemed to me to justify the cautious trial of the drug in man.

Method of administration.—The curare used in this series of cases was given to me by Sir Charles Sherrington, who obtained it from South America some thirty years ago. It was a resinous mass of the consistency of hard toffee, and was incompletely soluble in water. Messrs. Burroughs Wellcome filtered it and sterilized it by autoclaving, and supplied me with the drug in ampoules of suitable strength. Doses corresponding to from 2 to 20 milligrammes of the original curare were the final quantities used. The drug was given hypodermically. Thirty patients have been treated.[1]

Symptoms and signs.—For about ten minutes after injection no symptoms are recorded. At the end of this period, or between it and thirty minutes after the injection, headache and slight giddiness were described by most patients. These symptoms were aggravated on standing. They were found invariably to be associated with a fall of systolic blood-pressure of some 20 millimetres of mercury. This could be counteracted and the headache entirely relieved by administering 5 or 10 minims of adrenalin with or shortly after the curare injection. The headache was found to vary directly with the fall in blood-pressure. Accompanying this fall, and commensurate with it, was a fall in pulse-rate, the pulse frequently reaching 60 or a lower figure in patients whose normal was about 80. [In the dog, extreme slowing of the heart-rate, with extrasystoles and marked sinus arrhythmia occur.] With the giddiness a non-persistent lateral nystagmus could be elicited in some cases on lateral fixation of the eyes. In the cases in which the giddiness was most marked, an irregular ataxia was noted and these patients would describe their condition as being " stupid " or " fuddled." No other abnormalities of the central nervous system were detected. There was a tendency for all these symptoms to diminish as treatment was continued, but in the earlier stages the palpitations and discomfort of adrenalin were preferred to the headache and giddiness caused by curare.

Observations on rigidity.—Observations on muscular rigidity were divided into two groups: (1) General change in rigidity, including general clinical observations, the patient's ability to perform movements, his symptoms and the observations of the nursing staff. (2) Specific measurements of changes in rigidity of certain muscles.

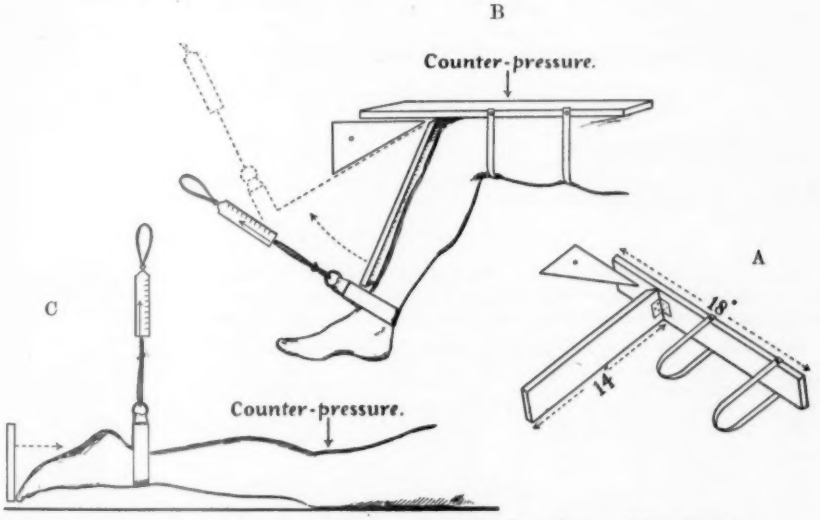
Rigidity or spasticity involving the flexors of the elbow or of the knee was chosen for measurement whenever possible, and in these cases I used a simple apparatus designed for me by Professor Hartridge, an illustration of which is given. It consists of a wooden board 18 or 20 in. long and 3 or 4 in. wide to which is hinged a similar board 14 in. long. The hinge is 4 or 5 in. from one end of the first board. In the case of the knee this latter is strapped along the extensor surface of the thigh so that the hinge lies over the knee-joint with the patient sitting in a chair. The second board will lie along the dependent lower leg. Extension is applied by means of a spring balance tied to the ankle and the force required to produce a given extension (which is most readily measured by a set square of appropriate angle inserted between the two boards) is measured in pounds. Care is taken to take the same time over the movement of extension on each occasion. In cases of spastic paraplegia or hemiplegia the initial movement registers a high tension, in view of the phenomenon of " clasp knife " rigidity. In extrapyramidal rigidity there is at first a bewildering irregularity in the degree of rigidity, but it is surprising how this settles down if rapid rhythmical movements of extension and flexion are made. The strength of the spring balance and the proportions of the wooden instrument can be altered to suit the requirements of the case.

Diseases studied.—As curare in safe and controlled dosage is a new drug in medicine, I am trying it in a wide series of cases. In this paper, I wish to present

[1] I am indebted to the staff of the Hospital for Epilepsy and Paralysis, Maida Vale, for a number of the cases investigated.

the results in a preliminary series of seventeen patients, including two cases of epilepsy, five of rigidity due to pyramidal lesions, and five patients suffering from rigidity of the Parkinsonian type. The remainder comprise certain positive results among a variety of investigations suggested by various hypotheses of the action of curare.

Epilepsy.—The results in epilepsy have hitherto been entirely negative, and in view of one critical observation, I have for the time being abandoned curare in these cases. This critical observation was on a patient who, for months, had suffered five or six fits during each night between 8 p.m. and 8 a.m. Curare was given hypodermically each evening and as it made no difference to the frequency or character of the attacks, the dose was gradually increased. Finally, a point was reached at which the patient complained that half an hour after his injection his neck muscles were so weak that he was unable to lift his head from the pillow. I examined him when he was in this condition and found a considerable difference in



Apparatus.—A for measuring rigidity in paraplegia, B in flexion, C in extension.

the power of various muscles. He felt not the slightest embarrassment to respiration and this confirmed observations made on dogs. His heart, though slow, was regular. The flexor muscles of the neck were definitely weak. The patient could rotate his head but could not lift it. Muscular power in the limbs appeared normal. While I was moving his right arm about the limb began to jerk spontaneously and a Jacksonian fit spread to the face and became generalized. If higher dosage becomes possible, however, I propose to investigate selected cases of epilepsy further.

Pyramidal disease (hemiplegia, paraplegia).—

Case I.—A case of paraplegia in flexion, due to syphilitic myelitis of seven years' standing, with a very severe and constant flexor contraction of both legs at the knee. A much less severe degree of flexion spasm occurred at the hips. The spasm had been present without intermission, other than momentary—for instance, in a hot bath—for eight months.

First observations.—Passive extension of left and right knee-joints was possible to about thirty degrees from full extension. Active extension was possible to a less degree. Four

milligrammes of curare extract were administered hypodermically. After ten minutes a little giddiness was felt by the patient. After twenty minutes the patient declared her legs to be "looser." The right knee could now be extended to ten degrees short of full extension, the left a little short of this. The patient was able to walk with the assistance of a stick in a way which was not possible before. After twenty-four hours the legs were still observed to be "looser" by the patient, the ward sister and the masseuse. After forty-eight hours the legs were stiff again and declared by the patient to be "worse than ever." Five subsequent injections of approximately the same dose were each followed by decreased rigidity for from twenty to forty-eight hours. On the nineteenth day of treatment and on the occasion of the seventh injection, the apparatus described above was introduced. Extension of the left leg to thirty degrees from full extension required a force of 30 lb. (an average of six readings) before the injection, and 8 lb. (an average of six readings) after the injection (Table I). This patient improved considerably on injections of curare two or three times a week. Removal of curare for three days led to an increase in spasticity.

TABLE I.—CURARE "A" ABOUT 10 MGM.: REDUCTION OF RIGIDITY.

Patient	Disease	Joint movement	Rigidity		Control	
			Before lb.	After lb.	Before lb.	After lb.
P1, M.M. ...	Paraplegia in flexion ...	Left knee extension (1) ...	30	8	—	—
		,, ,, (2) ...	32	8	—	—
		,, ,, (3) ...	28	8	—	—
		Right knee extension ...	20	6	—	—
					Right side	
P2, E.S. ...	Hemiplegia (left) ...	Left knee flexion (1) ...	16	10	—	—
		,, ,, (2) ...	11	10	8	8
P3, H.E. ...	Left hemiplegia ...	Left elbow extension ...	11	4	3	2½
E4, F.I. ...	Post-encephalitic rigidity	Left knee flexion ...	10	6	—	—
		Left elbow flexion ...	6→4	2→1		
		Left elbow extension ...	9→6	2½→1¾		

This patient was troubled with giddiness following the injection of curare only when she was standing or sitting. Observations of blood-pressure gave a reading of 140/82 before curare, and 130/80 forty minutes after the injection was given (Tables II and III).

TABLE II.—CURARE "A" 5 TO 10 MGM. VASCULAR CHANGES.

Patient	Initial blood-pressure	Reduced to	After	Initial pulse-rate	Reduced to	Headache or giddiness
P3 ...	128/90 ...	128/90 ...	45 minutes ...	76 ...	70 ...	Giddiness only
P2 ...	125/70 ...	110/60 ...	40 ,, ...	108 ...	90 ...	Headache* Giddiness*
E1 ...	150/90 ...	124/80 ...	*c.* 35 ,, ...	— ...	— ...	—
P4 ...	120/60 ...	94/60† ...	*c.* 35 ,, ...	74 ...	60† ...	Headache* Giddiness*
E4 ...	140/75 ...	106/60‡ ...	40 ,, ...	— ...	— ...	—

†Hypotension persisted for 12 hours. ‡For 3 days. *Cardiac extrasystoles.

TABLE III.—FALL OF BLOOD-PRESSURE WITH CURARE.

Average of 30 observations.

	Fall of blood-pressure	Fall of pulse-rate
After 15 minutes ...	17 systolic fall, 7 diastolic fall	... 9
,, 15-30 minutes ...	12½ ,, 7 ,,	... 5½
,, 30-60 ,, ...	10 ,, 5 ,,	... 6½
,, 2-12 hours ...	7 ,, 4 ,,	... —

Case II.—A case of vascular hemiplegia five months previously occurring in a woman aged 45. The patient was unable to walk, the left leg was spastic in extension; the left arm had very slight flexion spasticity, but was still very weak. Leg-flexion to thirty degrees from full extension required a force of 16 lb. on the left side, and 8 lb. on the right side, this latter being due to the weight of the limb. Eight milligrammes of curare extract were given as an initial dose. Forty-five minutes later the patient complained of a headache, and said that her paralysed arm "felt very light." Ten minutes later a force of 11 lb. was required to flex the left leg, 8 lb. being still required for the right. The patient moved her leg more readily than previously. She was much troubled by headache, and said that she felt "muddled," but she soon went to sleep. Forty-eight hours later the force required for

flexion of the left leg was 18 lb., that for the right being 10 lb. Six subsequent observations with the spring balance showed similar results. Within three weeks from the commencement of treatment with curare a definite improvement from her previously static condition was noted; she walked better, and could turn herself over in bed from shortly after the time the injections started. Improvement was noted until the injections were stopped, when walking was definitely worse. She improved three days after recommencing the injections. After individual injections headache and giddiness occurred from twenty to forty minutes after administration of the drug. On standing, at the height of the giddiness, a general ataxia was noted. The cardio-vascular system of this patient was more thoroughly investigated than in Case I. The initial blood-pressure was 125/60. Forty-five minutes after curare it was 110/60. The pulse-rate had fallen from 108 to 90. As treatment continued there was a tendency for lower blood-pressure levels to be obtained, but on each occasion a fall of systolic pressure occurred at the time of the giddiness and headache, and this fall was accompanied by a fall in pulse-rate. On adding 20 minims of adrenalin to the injection, the blood-pressure rose in five minutes from 118/78 to 132/90, and in fifteen minutes to 170/90 (Table IV). Palpitations and slight headache occurred, but there was not a trace of giddiness. A quarter of an hour later the blood-pressure had fallen to 126/80. Subsequent reduction of the dose of adrenalin to 5 or 10 minims enabled me to keep the blood-pressure comparatively constant and to avoid all headache and giddiness, though there was usually some palpitation.

TABLE IV.—CURARE "A" 5 TO 10 MGM. + ADRENALIN ♏ 10 TO 20.

	Blood-pressure initial	Adrenalin ♏	Blood-pressure after 5 min.	Blood-pressure after 15 min.	Blood-pressure after 30 min.	Symptoms: Palpitation	Symptoms: Headache or giddiness	Headache and giddiness with Curare alone	
P2 (i)	118/78	xx	132/90	170/90	126/80	Slight	O	+	+
(ii)	130/82	x	150/90	135/80	130/80	O	Slight headache after 30 minutes	+	+
Pulse-rate ...	76	—	—	86	96				
Control 1 (normal)	125/80	xv	180/?	180/?	135/80	+	O		
Control 2 (curare hypotension)	110/52	viiss	110/52	112/?45	120/60				

Case III.—Left-sided vascular hemiplegia of four years' duration in a woman aged about 45. The arm was in considerable rigidity, passive extension could move it only to within ten degrees of full extension. The hand was flexed to ninety degrees on the forearm and the fingers were adducted. It was quite impossible to extend the fingers passively, though the patient said that they became relaxed when she yawned. The extension of the left forearm on the arm required a force of 11 lb., while the same movement on the right side required only 3 lb. The blood-pressure was 138/90, the pulse-rate 76. Six milligrammes of curare were given hypodermically. After forty minutes the left arm could be extended with a force of 6 lb., the right requiring 4 lb. The blood-pressure was 128/90, the pulse-rate 70. A second injection of the same quantity was given. Ten minutes later extension of the left arm required a force of 8 lb. and 40 minutes later one of 4 lb. The blood-pressure was 132/80, the pulse-rate 64. The fingers could be extended passively but not actively.

Case IV.—Right-sided hemiplegic contraction, lasting since birth, in a girl aged 13. Spontaneous athetoid movements occurred from time to time and the arm would take up unusual postures sometimes for a considerable period. Curare in increasing doses up to 12 milligrammes was given and it was not until this dosage was reached that symptoms were noticed. The injection was followed by nystagmus on fixing the eyes to the left. There was no diplopia. The child was a little giddy on walking, the arm hung almost flaccid by the side. Passive flexion encountered no resistance, extension was met by a temporary clasp-knife rigidity, which gave way to allow full extension in a manner which had not been possible before. The first dose in this case produced a marked fall in blood-pressure from 120/60 (pulse 74) to 94/6 (pulse 60) and this hypotension remained for over twelve hours. Four days later the blood-pressure was 122/64 and the pulse 84. Cardiac extrasystoles occurred when the pulse-rate was at its lowest.

Case V.—Spastic paraplegia from disseminated sclerosis of long standing. The condition was one of paraplegia in flexion with a great deal of adduction spasm. Injections of curare produced very varying results on this patient, but at no time was the reduction of spasticity very obvious. The best record was a reduction of from 14 lb. to 8 lb. in the force required to separate the knees by 6 in. In the former case a force of 6 lb. was required to keep the

knees separate, and in the latter 5 lb. It was impossible to place much reliance on the figures obtained. The patient's subjective improvement is to be accepted with caution.

Extrapyramidal disease, Parkinsonian rigidity.

Case I.: A case of stationary chronic encephalitis with a well-marked tremor rigidity syndrome. The patient was a man aged 24 years. The tremor was more marked than the rigidity. The left leg shook violently from time to time. This was the first case of other than desperate illness in which I gave curare. The drug was started in minute doses, and it was not until 7 milligrammes were given that definite symptoms appeared. Twenty-five minutes after this dose the rigidity in the arms was almost abolished, but the tremor was increased in amplitude. The patient mentioned a sensation of pins and needles in the palm of the left hand, spreading upwards to the elbow. Rigidity remained in abeyance for two and a half hours. With larger doses headache was noticed. 13 milligrammes produced a sensation of slight weakness in the legs. The effective dose for the removal of rigidity was ultimately found to be between 5 and 7 milligrammes. This patient found hyoscine given hypodermically to be his best relief, in view of tremor, rather than rigidity, being his chief disablement.

Case II.—An established case of Parkinsonian rigidity in a woman aged 59. This patient's disease had reached a disabling stage, she was unable to walk unsupported, had not been able to write a letter for six months and was unable to turn in bed at the time treatment commenced. "Cogwheel" rigidity was considerable and a slight pill-rolling tremor was present. Twelve milligrammes was the minimum effective dose. Ten minutes after injection the rigidity in the arms was reduced, but the tremor remained; there was no apparent weakness. After half an hour the patient was able to walk, though very poorly and with much assistance. Reduction of leg rigidity was apparent at this time. Forty minutes after the injection there was some return of rigidity. On the next day 12 milligrammes of curare were combined with 1/100th grain of hyoscine by mouth. Subsequently the patient walked unsupported but with a tendency to propulsion. On this occasion improvement was maintained for a longer period. There was no doubt about the improvement in walking on the subsequent day, but the patient had been transferred from hyoscine by mouth to hyoscine hypodermically, and this rendered the significance of her improvement uncertain. She was now kept on hyoscine hypodermically, and subsequent experiments with curare were made in addition to this. Days on which curare was given were reported as better walking days by the massage department. The patient improved steadily, becoming able to walk alone and to write letters. She ultimately regarded hyoscine alone as being as helpful to her as hyoscine with curare, but there was no doubt about the relaxation which curare gave her in the earlier stages of treatment.

Case III.—A post-encephalitic aged 27. A case with moderate tremor and slight rigidity and also with oculo-gyral and static crises. Cogwheel rigidity of the right leg was found suitable for measurement. The patient was placed on his face and the force required to flex the extended lower leg at a given speed was measured. Constant readings were not obtained but an average of the readings was 10 lb. Fourteen milligrammes of curare were given, and one hour later an additional 6 milligrammes. Ten minutes after the second injection renewed measurements gave readings averaging 6 lb. for the same movement of the leg. The blood-pressure had fallen from 130 systolic to 104 systolic, the patient walked better with a longer stride and with an easier movement. Three days later 20 milligrammes of curare again improved his movement and lessened his rigidity for some hours. The patient had not been on adequate treatment and subsequent replacement of curare by hyoscine and belladonna led to a further improvement in walking.

Case IV.—A youth, aged 18, with a history of acute encephalitis in 1924 and rigidity of arms and legs from 1929 to 1931. The patient has advanced—and advancing—Parkinsonism and has had large doses of hyoscine, balladonna and stramonium without much improvement resulting. At 3.30 on one afternoon his walking was tested and his rigidity measured (Table I, E4). At 3.35 8 milligrammes of curare was given. At 3.55 he rose quickly from his chair and walked across the room swinging his arms in a way quite different from his previous performance. Measurement of rigidity showed a decrease (Table I, E4). He was sent home on his usual treatment. A week later his mother reported that he had dressed himself and had washed up the tea-things throughout the week, things which he had not done for many months previously. On the strength of this improvement the boy was admitted to hospital and given daily injections of curare. The first excellent results were not

maintained however, and after some weeks in which he became very depressed and suffered from increasing oculo-gyral and static crises, he was found to do better on stramonium than on curare. Stramonium improved him for a short time only however, and was in its turn eclipsed by hyoscine. This then proved to be one of those cases which respond excellently to a standard treatment of chronic encephalitis, but only do so for a short time. Curare, in the form in which I was using it, appeared to have taken its place amongst these treatments. The marked vascular hypotonia resulting from curare in this case is shown in Table 2, E4.

Table IV (Control 2) shows the subsequent response to adrenalin, which was delayed and poor, and in marked contrast to that of a normal individual.

Curare in other conditions.—(1) "*Causalgia*" (?)—A case not unfamiliar in type, of pain down the left arm and in the palm and fingers of the left hand, with "pins and needles," and tenderness at the root of the neck "for years." There had been little relief with thyroid extract, bromide mixtures and radiant heat therapy. There was no apparent vascular spasm. The patient was a woman aged 57. Four milligrammes of curare partially removed the pain and paræsthesia in fifteen minutes and both were absent after thirty minutes. The patient volunteered that she could move her fingers about better. A fall in blood-pressure and pulse-rate accompanied the improvement, which lasted one and a half hours. A second experiment is shown in the following table:—

Time	Injection	Blood-pressure	P	Symptoms
2.30	— ...	160/100 ...	80	Pain severe and continuous from shoulder to fingers throughout the day
2.38	Curare 8 mgm.			
2.50	" ...	135-138/80 ...	64	Pain less in shoulder
3. 0	" ...	143-150/80 ...	66	No pain above elbow
3.15	" ...	— ...	—	Pain remains in hand only. Severe headache
3.25	" ...	— ...	58	Pain in one spot in the palm and in the fourth and fifth fingers. Severe headache
3.40	Adrenalin mxx			
3.45	" ...	158/70 ...	—	Headache suddenly vanished
4. 0	" ...	152/? ...	80	A little pain in fifth finger. "Fingers move more easily." Relief: two hours. Dull ache only: one day

Inconstant from beat to beat, with extrasystoles.

There was total relief of pain for two hours, and a dull ache only for a day. The patient was used to severe pain.

(2) *Spasm of the orbicularis oculi*, of intermittent but daily occurrence was relieved for five days following one injection of curare. Subsequent injections had effects for shorter periods.

(3) *Arterial hypertension with arterio-sclerosis.*—Two cases with systolic pressures of 270 and 280 mm. Hg respectively. Both failed to respond to curare by a fall in pressure. Instead, both underwent a rise of arterial pressure of from 10 to 16 mm during the fifteen minutes after injection. It would not then appear probable that falls in blood-pressure are due to cardiac weakness.

The possibilities of curare therapeutically.—A forecast on this subject demands a survey of a number of aspects of a most interesting problem. The first of these involves an answer to the question "What is curare?"

Curare (or "urali," to give it the best known of its many alternative names) is a resinous arrow-head poison which kills by muscular paralysis and consequent asphyxia. It occurs under various names in many wild areas of the world, but the best known of these are the Amazon basin, the Orinoco basin and Guiana; and it is

only from these areas that the specimens in the Royal Botanical Gardens come. It is a matter of interest to learn that Sir Walter Raleigh [14] described the action of the poison and hoped to find an antidote.

In the first half of last century Humboldt [15], Waterton [16] and the Schomburgks [17, 18] saw the poison prepared by evaporation and mixture of plant extracts and it was Sir Robert Schomburgk who identified the chief plant ingredient as a member of the strychnos species to which he gave the name *Strychnos toxifera*.

In 1897 Quelch [19] recorded the preparation and the ingredients of the mixture as described by Waterton and Schomburgk and compared them with his own observations in the same areas of the Kanuku mountains of Guiana. He found that from three to eight plants entered the brew. The majority of the plants were poisonous, and in one curare four plants were apparently of the strychnos species. But the most constant ingredient of the varied brews was the bark of the ligneous vine, *Strychnos toxifera*.

The black resin of the curare is put up in various ways for transit and protection; notably in gourds containing some two ounces, in earthenware pots of varying sizes and in bamboo sticks. It is said that these varying vehicles are related to varying strengths of curare.

Boehm [3] has described three separate alkaloids as being present in "pot" curare, two further ones in "tube" curare and two, different again, in "gourd" or "calabash" curare. These vary very much in their paralysing properties, and at least one alkaloid—curine—is lacking in paralysing power in its naturally occurring form (Spath, etc. [5]).

But while various curares have various strengths of paralytic action, Prof. Hartridge and I found only two specimens out of seven to possess the power of removing tetany in the dog, without causing paralysis. It is one of these two successful specimens which has the action I have just described in man.

The second question before us then is: Does curare contain a second active principle for the removal of these rigid states? Such a second substance might act as a central depressant or might still act peripherally but in some way selectively.

I thought that possibly some light might be thrown on this matter by employing one of the synthetic preparations of quaternary ammonium bases, which have a curare-like action in regard to paralysis. I used octyl-trimethyl ammonium iodide, very kindly prepared for me by the Wellcome Physiological Research Institute according to the formula of Dr. Ing, who has recently described the action of this base [20]. It has unfortunately been impossible to carry these tests very far. The drug caused severe vomiting and prostration in the dog and it was impossible to press the dosage to the point of obtaining any specific pharmacological effect. Small ascending doses have been given to man, but these again produced nausea and had to be abandoned.

The question of an action of curare at the periphery, which is selective in its removal of these varied forms of rigidity, and also of the clonic and the tonic states of tetany in the dog, is both an interesting and a difficult one. In the case of decerebrate rigidity in the cat, Bremer and his colleagues think that curare produces its selective action by affecting more readily nerve-endings which are continuously in action than those which are resting. These authors cite the Wedensky phenomenon in which partial narcosis will permit the passage of one electrical stimulus of threshold strength, but inhibits succeeding stimuli. They found that with curarization of a degree which diminished tone but left the tendon reflexes intact, the muscle responded fully to isolated stimuli, but when repeated stimulation reached a certain frequency—which might be quite low—the muscle response "showed the sinking down typical of Wedensky inhibition." They suggest that "the tonic impulses, continuously arriving at the neuromuscular junctions of the fibres engaged in postural tone, are similarly blocked" by weak curare. Dr. Bremer thinks that

the selective removal of tetany in dogs, which Hartridge and I have described, can be explained along similar lines. There are, however, difficulties in accepting such an explanation, particularly in view of the removal of the short-duration, clonic contractions which are a common feature of dogs in tetany, and even more in the fact that these are removed in doses which leave intact the power of normal voluntary movements, such as walking.

In the event of our being forced to regard this selective action of curare as peripheral, certain possibilities call for consideration.

In the first place, there calls for elimination the possibility of afferent impulses from the periphery being affected. For all these rigid states, including tetany [21], are modified by deafferentation. It must be noted, however, that Mathews [22] finds no modification in the ascending discharge from the muscle spindle resulting from curarization in any doses inadequate to cause paralysis.

Secondly, there is the possibility of the myoneural junction being a more selective apparatus than it is usually considered to be. I have in mind a structure upon which curare could actually act selectively, removing discharges of certain electrical patterns, while allowing others to pass. Dale and Gaddum [24] have shown with great clearness that stimulation of the nerves to the blood-vessels of the tongue, by the local production of acetyl choline, can cause the contraction of this organ when its motor innervation has been removed. If such an action is upon the remaining myoneural junctions (as it seems it may be) these would appear to have become sensitized by denervation to the peculiar form of stimulation presented. Whether some such mechanism could involve the autonomic nervous system as offering to these pathological rigidities a contribution which is specifically removed by an action of curare on the myoneural junction, is entirely speculative. But the relationship of curare—or rather of the active principles which it contains—to the autonomic system deserves investigation.

The next step in the elucidation of the pharmacological problem is, I think, a renewed attempt to separate the various constituents of curare. The approach is twofold: by obtaining the ingredient plants separately and assaying them, and by chemical analysis of the final product as it reaches this country. I am glad to say that investigations along both these lines are already in progress.

From the therapeutic point of view this communication is preliminary and tentative. The rigidity-reducing—or "lissive"[1]—agent is apparently absent or inadequately present in some samples, and there is still difficulty in guaranteeing supplies of suitable curare. There are, however, all too few drugs with lissive properties, and it appears worth while exploring this somewhat intricate new one. It is hardly necessary to issue a warning against the rough and ready trial of unstandardized preparations in which the presence and the range of dosage of the lissive factor have not been determined. Hitherto I have found the dog the best subject for standardization of the various curares I have recently tried.

From the pharmacological aspect, we have in curare a drug which presents new subtleties for study, and from the point of view of neurological theory much of interest depends on whether the selective action described proves to be central or peripheral in its site.

Summary.

(1) A specimen of curare has been administered, as a sterilized hypodermic injection, to man in thirty cases. Seventeen cases are here reported.

(2) In doses which produce no detectable signs of weakness of voluntary muscular power, a definite, measurable reduction in the muscular rigidity resulting from diseases of the pyramidal and the extrapyramidal motor systems is recorded.

[1] O.E., *lithe* = soft. Cogn. with L. *lentus* = pliant. (*Cf. lissom.*)

Rigidity became lessened in from ten to forty minutes after administration of the drug and this reduction lasted for from two to forty-eight hours.

(3) Clinical improvement coincided with the registrable changes, and massage and physical exercises were facilitated while the patients were under the influence of the drug.

(4) Certain other events are recorded. This curare produced a fall in blood-pressure and in pulse-rate, accompanied by headache and giddiness, coincidentally with its reduction of muscular rigidity. These events were prevented by an adequate injection of adrenalin with the curare. Adrenalin did not appear to modify the "lissive" action of the drug.

(5) The actions described appear to forecast a place for curare, or for one or more of its derivatives, in therapeutics. Opportunity has not occurred for a trial of curare in tetanus, hydrophobia or strychnine poisoning.

(6) Certain theoretical aspects of the action of curare are considered, and the fact that it is not a unity, or even of constant composition, emphasized.

(7) A need of further chemical and physiological assay of curare is stressed.

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Dr. C. P. BLACKER read a paper on "Human Pedigrees." He explained the schedule prepared and published by the Eugenics Society and entitled, "How to Prepare a Family Pedigree."

[*October* 15, 1931.]

Herpes Zoster[1] involving Left Quadratus Lumborum and Oblique Muscles, with Complete Reaction of Degeneration. Lumbar Pseudo-Hernia in Region of Scars.—A. DICKSON WRIGHT, M.S.

Patient, a man, aged 60, three months and a half ago had a typical attack of herpes zoster on the left side, involving the tenth and eleventh dorsal segments. Since then the muscles on the left side of the abdomen have shown marked weakness, with the development of a lumbar pseudo-hernia, for which he wears a support.

Present condition.—Well-marked recent herpetic scarring on left side of abdomen and back from middle line of front to back, as high as the navel and extending nearly to the groin.

On exertion, as in rolling over towards the right, the ventral hernia through the weak quadratus lumborum and external oblique can be seen.

On electrical testing, there is well-marked complete reaction of degeneration of these muscles.

[1] Publication of these notes was held over owing to the illness of the author.

Section of Physical Medicine.

President—Dr. F. G. THOMSON.

[*February* 19, 1932.]

Modern Physiotherapeutic Measures.

By Dr. GUNNAR KAHLMETER (*Stockholm*).

IN this paper I am afraid that I shall not say much about modern physiotherapy generally that is not already known to you, but I thought that a subject with which you might perhaps be less familiar would be the use of X-rays in the treatment of rheumatic disease, a therapeutic method of which in recent years I have had a fair experience.

Physical forms of treatment, like other therapeutic measures, have their definite indications. As in all other therapies, the prescription of physical measures must come as the logical sequence of the diagnostic and patho-physiological investigation of the case. There must be definite reasons why the one or the other form of physical treatment is prescribed.

I believe that people often employ these methods on their own account not only in unsuitable cases but also in an entirely unsuitable manner. One often hears a patient say: "I am going to cure myself by natural means." Yet only a practitioner with special knowledge can decide whether the disease is of a nature or in a stage that calls for physiotherapy at all, and, if so, of what kind. It is only practitioners with such special knowledge that are able subsequently during the treatment to estimate the patient's reaction to the treatment and proceed with it accordingly.

One criterion of a skilful therapeutist is that he is able to individualize the treatment. In chronic polyarthritis, for instance, it behoves us not infrequently to stretch the individualization even to that of joints. It may happen that in one and the same patient one joint may need treatment by orthopœdic measures, another by joint movements only, and a third may have to be treated by fixation, heat or perhaps X-rays. To obtain any result requires a specialized knowledge of the different physical methods.

In proceeding to deal with the special forms of physical therapy I will begin with massage, re-educative exercises, and mechanotherapy.

Massage.—I do not consider that massage holds the central position in physiotherapy still claimed for it by many workers. Massage is of great importance, for instance, in surgery, in the after-treatment of fractures; in neurology, for the treatment of flaccid peripheral paresis, and also in certain internal conditions—for combating, for example, certain circulatory disturbances, chronic constipation, etc., and in cases of myalgia. Yet I find that some forms of myalgia, especially if acute or if the patient is nervous, react badly to massage, and in neuralgia we commonly find that massage, at least of the heavier kind, obviously aggravates the trouble. In acute stages of sciatica and brachial neuralgia I nowadays never prescribe massage.

If we turn to the large group of chronic arthritis I believe massage has been, and in some places still is, over-rated. I admit that massage may be of value in some cases of chronic polyarthritis, particularly when there is a question of getting rid of remaining exudates and capsular thickenings, or to counteract muscular contractures and tendon shortenings. But the great importance of massage for restoring the muscular atrophy in arthritis has been greatly over-rated. It is to my mind useless trying to influence by massage atrophic muscles belonging to or situated near an ankylosed joint (e.g., in periarthritis of the shoulder-joint). As long as the joint is immobile the musculature will not regain its strength, no matter for how long massage is applied. And even if the joint is not ankylosed, it is not much use giving massage to the muscles so long as an arthritic process is going on in the joint. The muscular atrophy in arthritis is not exclusively or even mainly an inactivity atrophy but is also a reflex atrophy. It is only with the recovery of the arthritic process and when it is possible again to use the joint that the musculature is able to regain its strength, and then it does so—with or without massage—because the function of the joint is restored.

To restore the function of the joint is the most important task in all treatment of arthritis and from the first day the main question is to save it. It is important to have clear ideas about the three different clinical types into which changes in the joint in the later stages of arthritis can be divided, exudation in the joint, destruction of cartilage, and ankylosis, the last—in the majority of joints—being the most deleterious to the function.

Prevention of faulty positions and ankylosis is therefore our most important task in the treatment of arthritis. In tuberculous and septic arthritis it is often impossible to prevent ankylosis, and then one has to be content with securing ankylosis in the most favourable position.

Massage is of relatively little value to maintain the function of the joint and prevent malpositions. More important is treatment by movement, i.e., by re-education of the function. If a joint is kept absolutely at rest for a long time, not only does the vitality of the cartilage suffer, but shrinkage of the joint capsule of the periarticular tissues, adjacent tendons, and muscular attachments takes place. It is therefore of the greatest importance in all cases of arthritis, even when acute, to secure from the outset variation in the position of the joint in the course of the day.

One of the most important factors for successful treatment of arthritis is that the doctor either should himself practise minor orthopædics—i.e., the use of splints, extension appliances, and in later stages of the condition forcible corrections in plaster—or at least understand the orthopædic principles of the treatment and the possibility of consulting an orthopædic expert.[1] The more specialized orthopædic appliances, leather knee-caps, corsets, etc., should be used in many more cases of arthritis and often much earlier than is usual at present. How efficacious, for example, the treatment by corsets is in certain protracted cases of lumbago and sciatica associated with back-muscle insufficiency is probably known to everybody.

Treatment by movement—active and passive—is exceedingly important in arthritis. If there is the least risk of ankylosis one should proceed with movements, even in acute cases, as far as the pain permits. Naturally in such cases the movements should be given only for a short time every day, and always in a manner to avoid weight-bearing (knees, ankle-joints). Lately, if there has been a tendency to ankylosis, I have employed movements, active as well as passive, in fairly acute cases, even with patients in bed with a rather high temperature, and of such procedure I have had favourable experience. Elbow-joints and fingers particularly must be treated by movements at an early stage, as it is difficult to apply corrective splints.

[1] Vincent Coates in the excellent account of the functional treatment of joints in his "Rheumatoid Arthritis and its Treatment" puts forth principles which are in complete accord with those I have for long entertained and practised.

Treatment by movement often can and should be used in the early stages of arthritis, but it is of no less importance in the later stages. Often patients with severe rheumatoid arthritis who have been unable to move about for years may soon get rid of their pains sufficiently to allow their joints to be used, even if there is considerable destruction of cartilage, so long as they are not ankylosed. Therefore, one should try to keep the joints mobile as long as possible by active and passive movements, manual and mechanical treatment by movement extension apparatus, forcible corrections in plaster—preferably without anæsthesia—orthopædic appliances and operations, etc.

It is of importance that practitioners, and through them medical gymnasts and masseurs, should realize that in chronic articular rheumatism their prime efforts should be directed to movement and re-education.

Treatment by baths.—In the first place, bearing in mind the eminent importance of movement for retaining the function of the joints, no small share of the therapeutic value of baths for chronic arthritis is due to the greater care with which the patient himself can actively move his joints while in the water.

A modern physiotherapeutic department should therefore be provided, not only with devices for conveying the patient in and out of a small plunge-bath, but also with baths provided with banisters for walking exercises.

In Sweden we have the "mud-massage-bath," in which the mud is powerfully rubbed-in all over the body by two masseurs and then washed off by a shower- or immersion-bath. I should emphasize that in bath treatment, individualization is perhaps more important than in any other form of physiotherapy. Patients react quite differently, even if suffering from the same disease. Constitutional factors and the reaction of the nervous system mean a great deal here, hence it is most unsuitable to prescribe baths by rule-of-thumb. It is a condition similar to protein-shock therapy and many authors hold that at any rate part of the effect of baths would be explained as "shock-therapy."

One form of bath from which I have seen much benefit is the prolonged immersion bath. I began to employ these a few years ago for severe cases of lumbago and sciatica, reasoning that if the patient is kept lying in a bath for several hours, it should, by virtue of its thermal—as well as by its mechanical—effects, relax the muscular spasms which are an essential feature in cases of severe myalgia. I generally order the bath at a temperature at which the patient just avoids feeling cold, 36°-37° C. Warmer baths are too fatiguing when prolonged, as is required in these cases. I begin with a half-hour bath, and then increase the time gradually to 1 to 1½ hours—exceptionally, 2 hours. I have often seen a striking effect from these baths and now make frequent use of them.

Among the many thermal treatments in use I would mention a bath used since ancient times by the peasants in Sweden and Finland as a cleansing bath—the "badstun" (bath-hut); this was described by Professor Yrjö Kajava in the *Archives of Medical Hydrology*, 1928, iii, 110. It is a powerful steam-bath in which the patient stays for 10 to 15 minutes in a room heated to about 60° C. and filled with steam. Although originally used as a cleansing bath, the bath-hut undoubtedly has a good therapeutic effect in certain forms of arthritis due to disturbances in the metabolism, and also in some cases of painful panniculitis.

Local treatment by heat has an exceedingly wide usefulness, and the devices for producing the heat are innumerable. Radiant heat from electric bulbs or hot packs with different—dry, semi-fluid, or fluid—substances are most generally used nowadays.

Hot packs.—I have had most experience of mud, fango and paraffin. Generally I do not begin with such packs in cases of acute rheumatic fever or rheumatoid arthritis with fever, until the temperature and, above all, the sedimentation rate, have begun to approach normal. I have seen some effect from paraffin treatment which, however,

I use in somewhat different forms from those which I have seen in England. I use paraffin heated to 55° C. and poured into large bags of water-proof "Zellstoff," which surround the joint to be treated. The bags can be had in three different forms: stocking-shaped for the foot, tubular for the knee and "thumb-gloves" for the hands. The ends of the bags are closed and fastened securely round the extremity by means of a rubber band. The warm fluid paraffin is poured through a screw lid until the bag is well filled without being very tense. The bags hold from 1 to 1½ kilogram of paraffin. An oil-cloth is then wrapped round and the patient has to lie or sit with his "dressing" for 1½ hours—i.e., until the paraffin solidifies. The bag with the paraffin is then easily removed; the bag is discarded but the paraffin can, of course, be used many times over. The advantage of this treatment is that the patient can lie down or sit comfortably in any position he likes and that the treatment can be carried out anywhere, even in the patient's home.

From packs, both mud and fango as well as paraffin, it seems to me that most benefit is obtained in cases of protracted capsular swelling and chronic exudates into the joints. The weight of the pack may help here through its compressing effect. Moreover, it would seem as if moist heat sometimes has a more absorbent effect on the swelling than dry heat has, and causes greater relaxation in contractures of soft parts. I also think that packs as well as radiant heat are in this respect much superior to diathermy.

I cannot say that I have had a happy experience of diathermy in the treatment of either inflammatory arthritis or neuralgia. I find that painful joints are often aggravated by diathermy, and that it is rare that inflammatory swellings improve in infective cases. Better results are obtained in osteoarthritis, but it must be pointed out that correct technique is exceedingly important with regard to strength of current, size of electrodes, and—above all—their application. Acute and intense neuralgia can scarcely ever tolerate diathermy. I have had relatively the best results with diathermy in osteoarthritis deformans of the knee and hip-joints. The pains in these forms of arthritis are largely due to the accompanying muscular contractures associated with hyperfunction; they therefore yield best to treatment directed towards arresting the muscular contractures, e.g., rest in bed or bandages (especially in spondylosis deformans), careful massage, and movements without weighting the joint.

Apart from diathermy, four well-known forms of electrotherapy deserve use: faradization, the galvanic current, the high-frequency alternating current, and some forms of sinusoidal current.

A few words, however, may be said about the sinusoidal current. The usual sine-shaped alternating current is not without danger, especially for the heart, owing to its inconstant periodicity. A Swedish engineer, E. Waldner, has, however, devised an apparatus which, connected to the direct or alternating mains, gives a low-frequency sinusoidal alternating current with a constant periodicity, interrupted by no-current phases of the same length as one of the sine-phases. This current, called after the inventor, the "E. W. Current," has proved, on exacting experiments, to be absolutely harmless. I have tested it for nearly two years on a total of about 200 patients mostly suffering from myalgia and neuralgia but also from arthritis and headache, pains in suppurating sinuses, etc. The current has produced an immediate analgesic effect, particularly in myalgia and neuralgia. I also think I am right in saying that it shortens and mitigates the course of disease in these conditions. On the other hand, I have observed no obvious effect upon the arthritic process. In brief, this form of electrotherapy is at least as useful as diathermy, indeed even more so. The apparatus is easier to manage, less dangerous and cheaper than the diathermy apparatus and the patients prefer it. The apparatus is called "Elektro-Energon" and is manufactured by the A.B. "Durgo," of Stockholm.

Radiotherapy.—The substitutes for sunlight—the mercury-quartz lamp and the carbon arc-lamp—have long been in use. They have been advertised and irresponsibly pushed in the market; in consequence the general public imagines that sunlight treatment is good for almost any disease. Besides its clear indications—glandular and surgical tuberculosis, certain skin diseases, post-infectious anæmia and convalescent conditions—it seems to me that treatment by the quartz- or carbon arc-lamp is of decided benefit in certain protracted cases of chronic arthritis of infectious origin where reduced body-weight, anæmia, subfebrility and somewhat raised sedimentation rate point to some chronic infection.

Whether there is any difference in the therapeutic effect of the quartz- and the carbon arc-lamp (on general irradiation) has yet to be settled. The carbon arc is more expensive, takes more room, and is more troublesome to manage.

I have tested the Solarca-lamp in my hospital for twelve months and I am much pleased with it. Its effect is at least as good as that of the mercury-quartz-lamp; whether it can replace the carbon arc—as intended—at least for generalized irradiation, it is as yet too early to say.

Light therapy, from having been almost entirely empirical, has been raised to another plane through research, especially with regard to the selective biological effect of light of different wave-lengths. It is not unlikely that various kinds of monochromatic light may come to play some part in therapeutics.

Radium and X-rays.—The second large group of radiotherapy comprises radium and X-rays. I have little experience with radium, at any rate regarding its use percutaneously, in radio-active mud, "radium-pads," and so on. From my limited experience I am not convinced that radium whether for external or internal use has any unequivocal effect, at any rate in chronic arthritis of infectious origin and chronic myalgia.

X-ray treatment of neuralgia and arthritis is not new; as early as 1897 X-ray treatment was used for trigeminal neuralgia (by Gocht), and in the same year for polyarthritis (by Sokelow and a Swedish worker, Thor Stenbeck). For sciatica X-ray treatment does not seem to have come into use until 1907 (Freund).

With regard to arthritis, the fullest statistics have been published by Staunig, 1925 (400 cases), Kraus, 1927 (285 cases), Kahlmeter, 1929 (94 cases), 1930 (155 cases), 1931 (200 cases), and Renck 1929 (294 cases). The respective authors have, as a rule, considered the results very encouraging, and X-ray treatment been deemed of value in nearly every form of acute and chronic arthritis. It is suggestive that radiologists who have published their experiences are enthusiastic about it, and several maintain that there are few fields in X-ray therapy in which the results are so reliable and satisfactory as they are in arthritis (Staunig).

At present I have at my disposal a material of rheumatic cases treated by X-rays, comprising about 300 cases of arthritis, 120 cases of peritendinitis, and 150 cases of neuralgia. My continued experience is encouraging, and has caused me to make increasing use of X-ray treatment in these forms of disease.

The mode of action of the X-rays in these conditions still remains exceedingly obscure. In the case of neuralgia investigation is greatly handicapped by our limited knowledge of the ætiology and pathogenesis of this condition. In the probably fairly small group of neuralgias caused by inflammatory processes in the vertebral articulations, in the soft parts within the intervertebral foramina or round the funiculi—the "névralgies radiculaires" or "funiculaires" of the French—the treatment may influence the inflammatory process itself, in the first place by retrogression of young cell elements. In arthritis the effect of X-rays can probably thus be best explained, but in most cases of neuralgia there are not likely to be any inflammatory processes, whether in the tissues mentioned or in the nerve or its sheath.

There is, again, the view that X-ray irradiation would have a "retuning" or "stimulating" effect, thus being similar to protein-shock therapy. An argument against this is, however, that it is exceedingly rare to find any exacerbation of local symptoms, or any signs of a generalized effect in connection with the irradiation. Further, there is the possibility of influence upon the vasomotor conditions around the nerve roots. At present, however, one must be content with the fact that its analgesic effect is obvious in very many cases.

That X-ray irradiation has a generally analgesic effect we know from other fields of X-ray treatment, e.g., from the irradiation of malignant tumour metastases in the spine. But that its effect is not merely anæsthetic is clearly evident in the treatment of arthritis. Here also the earliest and most obvious effect is amelioration of pain, but in addition we often find an obvious reduction of any capsular swelling, and sometimes also a diminished exudate in the joint; this results in greater mobility, less painful movements and greater excursion, perhaps the most important effect of the X-ray treatment, at any rate for the further course of the arthritis. These effects are not noticed until two or three weeks after the commencement of treatment; sometimes, however, the analgesic effect becomes evident in a few days; moreover it is clear that the effect of the treatment is lasting. It is not unusual for the improvement, with regard to pains, swelling, and mobility, to continue for several months.

In judging the immediate results of X-ray treatment in neuralgia and arthritis, we meet great difficulties; not only has one largely to rely on the patient's own statements, but also many patients have been having other treatments simultaneously with the X-rays, and there may also be spontaneous improvements. As already mentioned, however, in arthritis one may often also notice improvement in the local condition. Moreover, not a few of my patients have been treated by X-rays exclusively. The possibility of spontaneous improvement cannot always be excluded, but often patients who have previously had all kinds of treatment with no benefit, volunteer the statement that it was only after X-ray treatment that they noticed decided improvement.

The arthritic cases in my material differ widely; even cases in the same clinical group represent different stages of the disease, from the clinical as well as the pathological point of view. In my classification I use a simple method, mainly following that adopted by the British Ministry of Health and by "La Ligue contre le Rhumatisme."

Although our therapeutic technique in cases of arthritis agrees in the main with that used in most places at present, we have introduced important modifications. In acute arthritis of gonorrhœal, septic, or rheumatoid ætiology we have employed during the past twelve months a dosage elaborated by our present radiological expert, Dr. Nils Westermark; it differs from that usually employed in that he uses the same technique as in other septic conditions, i.e., small absorption doses, usually with a copper filter. Over an area of the joint we have been giving as a first application 1/10-1/8 S.E.D. with a 0·5 mm. copper filter + 1 mm. aluminium.

The distance has been determined according to the depth required for the treatment and the size of the field to be treated. The distance has varied between 30 and 50 cm. After two or three days this dose is repeated over another area of the joint and after an equal interval a similar dose is given to a third area or perhaps again to the first. Should the symptoms rapidly disappear further treatment is postponed; if not, the treatment is repeated at intervals of two or three days, yet at most until 40 to 50% of 1 S.E.D. has been given to each field. If the arthritis has not fully recovered by that time, or if the process exacerbates, a similar therapeutic series is again given after about six weeks. These series may be continued according to the condition of the skin; generally no skin pigmentation

whatever results. In acute cases, however, three series at most are, as a rule, required—generally only one or two series.

In "subacute" rheumatoid arthritis (with less fever and of a more insidious onset) a similar technique is used, usually with somewhat larger doses, $\frac{1}{4}$ to $\frac{1}{3}$ S.E.D. An aluminium filter is used for the small joints and a copper filter for the large ones. The aggregate dose in each series is at most 50% of 1 S.E.D. If needed, new series are given at 6 to 8 weeks interval unless changes take place in the skin—an unusual happening with these doses.

In chronic rheumatoid arthritis and in osteoarthritis Westermark employs larger doses, generally $\frac{1}{4}$ to $\frac{1}{3}$ S.E.D. to each therapeutic field, with a few days between each application. A copper filter is used for the larger joints and an aluminium filter for the smaller. The series is repeated after 6 or 8 weeks. In the chronic cases in which these larger doses are used we do not give more than three series at the most.

Our previous Roentgen specialist, Dr. A. Akerlund, who has treated the greater proportion of my case material (1926—June 1, 1930) employed the same technique for the chronic arthritic cases as Dr. Westermark, but gave the same doses also for the acute cases. The former therefore used fewer but larger doses, the latter more but smaller. I cannot say that I have noticed any decided difference in the therapeutic effect between these two methods, nor did I find any damage to the skin caused by Akerlund's larger dose. It would seem, however, that to use smaller and more frequent doses would be more cautious and more biological in acute cases, wherefore this method is probably to be recommended in these cases, more so as the results in the more acute cases of rheumatoid arthritis and gonorrhœal and gouty arthritis seem slightly better.

For the smaller joints, the therapeutic fields have as a rule been two: dorsal and volar. The fields have extended over the whole joint, including its whole width, in finger- and toe-joints, the whole hand and foot respectively. With the larger joints, the fields have been three or four in front, behind, without, and for the knees within.

Peritendinitis.—This has been treated somewhat similarly to arthritis. In acute cases we give small and frequent doses of $\frac{1}{10}$ to $\frac{1}{8}$ S.E.D. at 30 to 40 cm. This dose is repeated over different fields at two-day intervals, altogether, at most, 40 to 50% of 1 S.E.D. A fresh series is given, if necessary, in from 4 to 6 weeks; however, this is rarely the case in acute peritendinitis. Chronic cases of peritendinitis have been given $\frac{1}{8}$ to $\frac{1}{4}$ S.E.D., distributed over two or three applications and in addition one or two such series at intervals of 4-6-8 weeks.

Neuralgia.—In brachial neuralgia, sciatica and trigeminal neuralgia we give, in acute cases in severe pain, first an "absorption dose," $\frac{1}{10}$ to $\frac{1}{8}$ S.E.D. with Cu-filter to the plexus or the root area. This is repeated every third day until at most 50% S.E.D. has been given. In chronic neuralgia, $\frac{1}{4}$ S.E.D. is given to the "root area" two or three times, at an interval of two days. According to requirements, one or two further such series are given at intervals of from 6 to 8 weeks.

Lumbago.—In lumbago the dosage used is similar to that in neuralgia, according to whethar it is an acute or a chronic form.

Table I shows all the 562 cases I have treated by X-rays during the period from 1926 to 1931.

TABLE I.—SUMMARY OF RESULTS.

Groups	Number of cases treated	Number of joints treated	Results: Good (free or nearly free from symptoms)	Middling (improved)	Bad (unimproved)
I. *Arthritis* :—					
(1) Rheumatoid arthritis ... (infective periarthritis)	180	458	60%	30%	10%
(2) Osteoarthritis :					
(*a*) of the knee-joint ...	51	87	40%	50%	10%
(*b*) malum coxæ senile	25	33	—	50%	50%
(3) Spondylosis rhizomelica	6	—	20%	80%	—
(4) Gonorrhœal arthritis ...	15	22	90%	10%	—
(5) Articular gout in subacute stage	10	22	60%	40%	—
II. *Peritendinitis* :—					
(Bursitis subacromialis, trochanterica and achillea)	122	152	90%	8%	2%
III. *Myalgia and neuralgia* :—					
(*a*) Lumbago	34	—	65%	28%	7%
(*b*) Sciatica	65	—	60%	25%	15%
(*c*) Brachial neuralgia ...	54	—	80%	15%	5%
	562				

The material includes different forms of arthritis and "peritendinitis" besides myalgia and neuralgia.

For each group I state the percentage of "good," "middling" and "bad" results. The result has been considered "good" when the cases have got rid of their symptoms or nearly so, in arthritic cases when pains on movement have disappeared, mobility become normal and capsular thickening entirely or almost disappeared. As "middling" results have been reckoned arthritic cases in which the pains on movement and capsular thickening have diminished and where the mobility has become greater but not normal. As "bad" results have been reckoned those in which no effect or only a brief effect of the treatment has been noticeable.

Such a classification has the disadvantage of being subjectively coloured but I have tried to make it as critical as possible, and I think the material is large enough to warrant some conclusions being drawn from the table. I wish to stress the fact that we are concerned here with the primary results as they appear a few weeks or months after the X-ray treatment. As to their duration we know nothing yet. I have made no after-examinations because only in a few cases has enough time elapsed since the treatment.

Referring to the table we find that the first—and largest—group is made up of 180 cases of rheumatoid arthritis with 458 treated joints; this group includes all subacute, subchronic and chronic cases of polyarthritis, both the "primary chronic" and the "secondary chronic" cases, the clearly "infective" as well as cases called by some authors "metabolic arthritis" and "climacteric arthritis." I have done so because our present knowledge of the morbid anatomy, ætiology, and pathogenesis of chronic polyarthritis does not permit of any natural classification either from the aetiological or from the pathological point of view. I feel that the different clinical groups can be better explained by individual constitutional factors and endocrine conditions.

Osteoarthritis deformans, on the other hand, differs fairly clearly from rheumatoid arthritis, owing first to its monarticular or oligoarticular character, secondly, to its morbid changes with characteristic absence of primary inflammatory changes in the synovial membrane, and, third, to the absence of signs of generalized infection. Rheumatoid arthritis is a disease affecting the whole organism; osteoarthritis is a local condition of joints.

The *rheumatoid arthritis* group is thus made up of 180 cases with 458 treated joints. Of the latter approximately 60% have shown a "good" effect of the X-ray treatment, about 20% a "middling" effect and 20% have not been appreciably influenced. These figures do not in themselves tell us very much, especially as the group includes cases of such varying types and stages. Naturally the more acute cases, and the chronic cases with only synovitis and no destruction of cartilage, have given better results than the chronic cases with advanced destruction in the joints. In acute cases, particularly those with relatively high fever, well-marked periarticular swelling and erythema of the skin (of septic type), the effect of X-ray treatment, is often astonishingly good and rapid. It is the rapid effect here that is of particular value, as these cases are especially liable to develop ankylosis and destruction of cartilage if the inflammatory synovitis and periarthritis do not speedily subside. Considering however, the serious nature of the majority of cases of rheumatoid arthritis, it is justifiable to conclude from the figures mentioned that X-ray treatment has, on the whole, yielded satisfactory results.

In Table II I have summarized the results (in cases of rheumatoid arthritis only) with reference to the different joints under treatment. Toes, metatarso-phalangeal joints, ankles and shoulder-joints show the best results, while fingers, wrists and knee-joints are less satisfactory. Strange to say the different joints in my material fall into practically the same order as in a tabulated account of a large number of rheumatoid cases treated by X-rays and recently published by G. Renck, a Swedish radiologist. (600 treated joints.)

TABLE II.—SURVEY OF RESULT OF TREATMENT OF RHEUMATOID ARTHRITIS CLASSIFIED ACCORDING TO THE JOINTS.

Joints treated	Number of joints	Recovered or much improved	Slightly improved	Unimproved
Finger	50	50%	30%	20%
Wrist	62	56%	25%	19%
Elbow	21	60%	30%	10%
Shoulder	49	71%	26%	3%
Toe- and metatarso-phalangeal ...	53	72%	23%	5%
Ankle	88	70%	23%	7%
Knee	135	45%	49%	6%
	458			

I am unable to offer any explanation of this obvious difference in susceptibility exhibited by the different joints. One might suppose that the joints most strained in everyday life would show a worse result, and this may well apply to fingers, hands and knees which have reacted less well to the treatment, but it is then difficult to explain why the foot-joints show good results in my material as well as in that of Renck.

If we turn to Table I, group I (2)—osteoarthritis—we find that the results here are worse than for the rheumatoid arthritis group. Osteoarthritis of the knee-joint includes not only traumatic osteoarthritis (including athletes) but also "primary" osteoarthritis of the aged ("erosion arthritis"), besides some cases of arthritis of the knee in women in the climacteric (generally also suffering from obesity), cases which might just as well have been labelled "climacteric arthritis."

This group comprises fifty-one cases with eighty-seven treated joints. In 40% of these the result was good, in 50% middling, and in 10% there was no effect. The result has been evident here not only by improvement or disappearance of the capsular thickening and exudate, but also in reduction of pains on movement. On the other hand the treatment has naturally had no effect upon destruction and deformity of joint cartilages. Not infrequently, however, the X-ray treatment seems to have an anæsthetizing effect upon the surfaces of the joint cartilages affected by

the destructive processes themselves, causing movements in the joint to become less painful, even if no painful synovitis has been present that might have been influenced by the treatment

As is, however, to be expected *a priori*, this effect on the painfulness of the cartilage itself on weight-bearing is neither very prominent nor of long standing. In full agreement with this we also find that the effect in " malum coxæ senile " is not great. In these cases there is, of course, as a rule, a pure deformity and sometimes destruction of the cartilage, but generally no synovitis. That there is any improvement at all in some cases of malum coxæ senile is probably due to the beneficial effect of X-rays upon the painful muscular contractures that often occur in these cases in the neighbourhood of the joint, owing to the hyperfunction of muscles resulting from the altered shape of the hip-joint. It is probably these muscular contractures that are favourably influenced by the X-ray treatment. Among the twenty-six cases of treated hip-joints none has shown any good effect from the treatment, about half have shown a middling result and the other half have shown no effect. Malum coxæ senile shows the least favourable therapeutic results and this is scarcely surprising.

I have referred a few cases of " spondylosis rhizomelica " to group I (3). This is a rare condition and the number of cases is small, but it is of so much clinical interest that I mention it separately. The ætiology of the disease is obscure, but that it is to be sought in some infection seems beyond doubt. In favour of this is, among other factors, the constantly raised sedimentation rate and the slight leucocytosis often present. Diagnosis in advanced cases is easy, but in earlier cases it may easily be overlooked and not a few cases of " muscular rheumatism " in the upper part of the back are probably spondylosis rhizomelica. In protracted " muscular rheumatism " in the interscapular region and the neck one should make it a rule to determine the sedimentation rate. If this is raised there can be no question of an ordinary myalgia, spondylosis rhizomelica being then more likely.

Treatment in this condition is rather futile, and the marked tendency to ankylosis is often impossible to overcome. The procedure I have adopted in recent years is to apply a leather corset; this has hastened the ankylosis, unavoidable in any case, in the middle and lower thoracic region, but has caused it to occur in a functionally relatively good position. In the cervical region, on the other hand, I have tried with every means at my disposal to maintain mobility. Here X-rays have been surprisingly useful. I have irradiated the whole cervical region, and have obtained a decided reduction of the pains, on rotation as well as on flexion. One has thereby been able to employ more active movement, and of five cases thus treated one patient was entirely relieved of symptoms in the neck, and the other four became much better. It is my decided opinion that in these cases X-rays afford a most valuable aid to an otherwise meagre therapy. I emphasize, however, that it is mainly the neck region that it is worth while to treat by X-rays.

X-rays have proved to have one of their most useful fields in gonorrhœal arthritis. I have treated fifteen such cases, with an aggregate of twenty-two joints. All were treated in a very early stage of the disease. The result has been brilliant, with 90% recoveries and 10% clearly improved. All were simultaneously treated by gonargin injections, but my earlier experience tells me that this alone yields neither so good nor so rapid an improvement. The effect of X-ray treatment has, as a rule, been astonishingly rapid, and how important this is for the " restitutio ad integrum " of the joint is known to everyone who has seen the rapid destruction and ankylosis which may develop. I do not hesitate to say that X-ray treatment is the treatment of choice in gonorrhœal arthritis, and it should be commenced immediately. High fever in gonorrhœal arthritis is no contra-indication, but the doses should be very small in acute cases.

X-rays are also of great use in certain forms of gouty arthritis. Most cases of acute gouty arthritis subside in a few days under medicinal treatment (colchicum and atophan, etc.), and in these cases X-rays are unnecessary. But if an acute attack of gout persists for more than a fortnight, one ought to apply X-rays. I have treated ten protracted cases of gout with an aggregate of twenty-two joints; full freedom from symptoms was obtained in 60% and considerable improvement in the remaining 40%. Even in gouty arthritis it is of the greatest importance for the future functioning of the joint to cause the acute inflammatory changes to subside as rapidly as possible, and here X-rays are probably the best form of physical therapy.

Another group of diseases in which X-rays are of very great value is peritendinitis; this term was introduced by Einar Perman, a Swedish worker, and corresponds to what in the literature is called "bursitis calculosa" and allied conditions. Bursitis in the shoulder region has long been known as bursitis subdeltoidea and subacromialis. It has also long been known that these forms of bursitis can often be seen on the radiogram by the calcium shadow produced by the contents. Perman showed that frequently the inflammatory processes are not located in the bursæ but around the tendons and the tendinous attachments, and also that they do not always show calcium shadows. He therefore suggested the name "peritendinitis calcificans" or "non-calcificans." Carl Sandström, a Swedish radiologist, showed that analogous forms of peritendinitis might become localized in the trochanteric region and also close to tendinous attachments at other joints, e.g. the elbows. Sandström, as also earlier Renck, another Swedish radiologist, have shown that X-rays have a good effect on this peritendinitis, in acute as well as chronic cases.

I have treated 152 such cases of peritendinitis (in 122 patients) and can verify the favourable results claimed; 90% of the cases recovered, 8% improved, and in 2% only was no effect obtained. Of my cases about 120 have been localized to the shoulder region, fifteen to the trochanteric region and the remainder to other places, of which ten were round about the attachment of the Achilles tendon. I have also treated by X-rays a few cases of calcanean spur and a few cases of epicondylitis of the elbow-joint—the so-called "tennis elbow"—all with good results. These strange clinical conditions are exceedingly resistant to every form of treatment, including prolonged rest, and have even been treated surgically. It is therefore of the greatest value to have found a treatment which in most cases leads to the desired goal.

With regard to the ætiology of peritendinitis and bursitis, they are generally considered to arise from traumata—especially slight repeated traumata—or through over exertion. This is undoubtedly an important cause, particularly in such cases as have, from the outset, been running an insidious chronic course. Peritendinitis of the shoulder-joint and at the Achilles tendon, as also epicondylitis of the elbow and calcanean spurs, often seem to have arisen in this way. Peritendinitis may, however, set in acutely, particularly in the shoulder, so acutely that the patient can state the hour of occurrence. It is then associated with intense pain, swelling, and sometimes redness, in front of the shoulder-joint and often a raised temperature. These acute attacks of peritendinitis remind me of acute attacks of gout and I have seen them in patients who had, earlier, had typical attacks of gout. I have also met with acute attacks of peritendinitis, though not of so violent an onset, often multiple, in rheumatic fever. There has been no doubt about the diagnosis as in several cases acute endocarditis was present besides affections of the neuro-muscular tissue as revealed by the electro-cardiograph. In such definite cases of rheumatic fever I have several times observed on the radiogram inflammatory osseous foci under the Achilles tendon, on the anterior aspect of the calcaneus, in the greater tuberosity of the humerus, and so on. It is of interest that the virus of rheumatic fever may attack, besides the heart and joints, the tendinous attachments and peritendinitic tissues, also my last group is that of neuralgia and myalgia. If our knowledge of the ætiology of chronic

arthritis is imperfect, it is still more so with regard to myalgia and neuralgia. In Scandinavia, especially in Denmark and Sweden, these questions have been actively discussed in recent years; one or two aspects of the ætiology and pathogenesis of myalgia and neuralgia have thus been clearly elucidated. Above all Lindstedt has clearly shown the great importance of idiosyncrasy in a patient in whom the pain assumes a neuralgic character. This "neuralgic tendency" may be constitutional, e.g. due to a congenital hypersensitive nervous system, or acquired, e.g., as a consequence of past infectious disease, general fatigue, psychic strain, emotions, etc.—in brief, anything that augments the general sensitiveness of the nervous system. It has further been shown by Hellweg, Lindstedt, and Kahlmeter, and others, in how very many cases muscular over-exertion determines the localization of the neuralgia or myalgia. Muscular over-exertion may be occasioned by the nature of work, posture, static conditions, such as flatfoot, diseased conditions of joints and muscles (paresis), etc.

Many cases of myalgia and neuralgia, especially lumbago, myalgia of the shoulder, sciatica and brachial neuralgia, probably arise through local muscular over-exertion in persons with congenital or acquired neuralgic tendency. In the strict sense of the word they are not therefore "rheumatic." In some cases, however, myalgia and neuralgia have undoubtedly different causation. There seems no doubt that a local chill may cause myalgia as well as neuralgia, similarly that these latter conditions may arise in connection with infections, rheumatic or otherwise. I would not like to express any opinion as to whether in these latter cases true myositis or neuritis are present or whether the infection only serves as the exciting factor in producing the "neuralgic tendency." True inflammatory processes are probably rare in muscles and nerve trunks. Such processes are probably more often present in the meningeal coverings of the spinal roots, in the tissues within the intervertebral foramina and in the articulations of the articular processes of the vertebræ. I should believe, however, that this group of neuralgia, the "névralgies radiculaires" of the French, is small.

The effect of X-rays on neuralgia and myalgia is such that they should be used extensively; of brachial neuralgia I have treated, as is seen in the table, 54 cases, of which 80% recovered, 15% improved, and 5% only remained unchanged. In acute brachial neuralgia X-ray treatment, I believe, yields the best and most rapid results. The therapeutic effect is already apparent one week after the end of the treatment, and often one series of applications is sufficient. Roentgen treatment is therefore not only simple and speedy but also inexpensive. In chronic cases, especially those due to over-exertion, the effect is not so rapid, but if the patient can rest the arm at the same time, the effect is generally good.

In sciatica the results are not quite so good; of my 65 cases 60% recovered, 25% improved, and 15% were unaffected. My cases of sciatica include many severe ones for which every possible treatment had been tried in vain, and considering this, the results must be allowed to be good. The results were naturally better for patients who remained in bed during treatment than for those who were up and about, namely 70% and 40% recoveries respectively. In cases in which obvious adverse static conditions were present—e.g., flatfoot, arthritis of the knee, overweight, &c.—the results were worse than in other cases. On the other hand, when there had been earlier attacks of sciatica, the results were not worse than with first attacks. Nor, strangely enough, are the results much worse in long-standing cases than in those in which X-ray treatment had been begun earlier. It is true that among those who previous to treatment had had symptoms for more than six months, 20% only fully recovered; but among those who had had sciatica for three to six months, exactly the same number (73%) were restored as among those who had the trouble for less than three months. It is also surprising that the result has been as good in patients over 40 years of age as in younger ones.

A question that naturally arises is whether the effect of X-ray treatment in neuralgia is only temporary or whether the risk of recurrence is less than after other treatments. I can supply no answer substantiated by figures, but it seems to me likely that risk of recurrence bears a closer relation to the ætiological factors, whether temporary or persistent, than to the kind of treatment. Even if, as is likely, X-ray treatment does not protect against recurrence more than other treatments do, it possesses the advantage of being easily carried out, causes little inconvenience, is quick, and often produces good results in cases that previously have been resistant.

If I can venture no opinion on the value of X-ray treatment in preventing recurrences of sciatica, I believe I can say that in some cases of lumbago it may have this value. I have not used X-rays for acute lumbago because that, as a rule, subsides after a short rest in bed and the application of heat. But I have used it in chronic lumbago, i.e., for patients who have been troubled almost continuously for years with pains in the sacral region, or by some weakness or feeling of "insecurity" in that region. I have further been using X-rays in cases of repeated attacks of acute lumbago which, although it subsides fairly quickly, repeatedly returns, in some instances many times a year. I have treated thirty-four such cases, of which there was freedom from symptoms for at least twelve months in 65% and improvement in 28%; in 7% only was the treatment without effect. I imagine that the extreme resistance of these types of lumbago is due to chronic irritation either in the lowermost attachments of the back muscles, or else to arthritic processes in the sacro-iliac joints or in the articulations of the lowermost articular processes. On account of their localization such changes would be difficult to get at by ordinary physical methods, while they should be readily accessible to treatment by X-rays.

As in all other treatment for neuralgia, it is difficult exactly to estimate the effect of X-rays. First one has almost exclusively to be content with data supplied by the patient himself; secondly, it is impossible to be certain about the part played by suggestion. One has to rely on personal impressions in such cases, built up on the experience of the effect of other therapeutic methods in similar cases. It is my decided opinion, however, that we have in X-ray therapy a valuable adjunct to the treatment of many forms of neuralgia, and a method that deserves to be much more frequently used than it is at present.

In different forms of arthritis we can more easily observe and estimate the value of the treatment; for this malady X-ray treatment is a form of physical therapy which ranks with methods of older date. Like all forms of therapy, X-rays have definite indications and limitations, but if the indications are correctly interpreted and the treatment is expert, we possess in this treatment an efficacious weapon by which we can combat those severe forms of disease generally described as rheumatic.

JOINT DISCUSSION No. 3.

Section of Medicine and Section of Surgery.

Chairman—Dr. H. MORLEY FLETCHER (President of the Section of Medicine).

[*February* 3, 1932.]

DISCUSSION ON DIAGNOSIS AND TREATMENT OF ABSCESS OF THE LUNG.

Dr. R. A. Young: Abscess of the lung is a subject which well merits a combined medical and surgical discussion, the more so that in most cases both medical and surgical methods have to be considered and the ultimate treatment is often a matter requiring careful assessment of evidence and nice judgment in decision. Improved methods of diagnosis and more careful clinical observation seem to show that the condition is more common than is generally supposed.

At the outset, it is necessary to consider what is meant by the expression, "abscess of the lung." The condition is certainly at first less sharply defined than circumscribed suppuration in other organs, owing to the complexity of the structure of the lung tissue and the special characters of the pulmonary blood supply.

A localized collection of pus within either lung may result in a variety of ways. From both the pathological and the clinical points of view, it is important to determine the manner in which the suppurative process involves the lung tissue, since the recognition of the origin and nature of the abscess may influence profoundly the prognosis and the choice of treatment.

It is difficult to classify the types of lung abscess and their causes, since the mode of origin is often complex, involving questions of vascular occlusion, as well as the action of pus-producing bacteria and the saprophytic or pathogenic action of anaerobic organisms and various spirochætes or treponemata.

Abscesses of the lung may be: (1) Abscesses due to inhalation of foreign bodies or infective material into the bronchi, especially during operations on the nose and throat, or to septic conditions in the nose and nasopharynx apart from operation. These I shall refer to as "inhalation abscesses." It is surprising to find that in a considerable number of the cases after operation the condition occurs in the upper lobe. (2) Parenchymatous abscesses, or abscesses originating in the lung parenchyma, due to what is often called a "pneumonitis," e.g., the so-called meta-pneumonic abscesses. (3) Embolic abscesses. These are usually multiple and result from septicæmic conditions, especially right-sided infective endocarditis, and from distant septic processes, such as otitis, appendicitis, and infective thrombo-phlebitis. (4) Abscesses from extension of suppurative processes in adjacent structures, notably the bronchi, mediastinum, abdominal organs (through the diaphragm) or from the vertebræ; among this group may be included "bronchiectatic abscesses." (5) Abscesses resulting from breaking-down new growth, or from necrotic changes in adjacent lung-tissue produced by obstructed vascular supply. Such abscesses are often in unusual situations and may give rise to difficulty or confusion in diagnosis. They constitute about 10% of the cases of pulmonary abscesses. (6) Abscesses resulting from perforation of the chest wall and from severe injury to the chest, involving fracture of ribs. (7) Gangrene of

the lung occurs under like conditions when the infective agent is specially virulent or the patient's condition is enfeebled or debilitated.

One of the conditions which most simulate abscess is interlobar empyema. The distinction may, in fact, be almost impossible. The diagnosis may be suggested by a meta-pneumonic history and by the situation of the signs in the axilla extending into the interscapular region. If rupture occurs, the absence of elastic tissue in the pus may be significant. The differentiation is, however, of secondary importance, since the condition is, in effect, an abscess within the lung, and its treatment is similar to that of abscess.

Bronchiectasis may give rise to more difficulty, but lipiodol usually establishes its presence without question.

New growth may be more difficult to exclude, since abscess often co-exists, but a study of the skiagrams, with lipiodol and sometimes bronchoscopic investigation, may prove the real nature of the condition.

The history of the patient's illness may afford the greatest assistance in the diagnosis of abscess of the lung. The occurrence of severe or fulminating pulmonary symptoms after operations upon the nose and throat, or after inhalation of a foreign body, should at once lead to suspicion. In cases of delayed resolution after pneumonia, severe and increasing fever, associated with the expectoration of obvious pus—especially if this be fœtid—is again significant. Acute symptoms with similar developments after pulmonary infarction, in association with thrombo-phlebitis, following on abdominal operations, or as a complication of suppurative ear disease, should lead to suspicion of abscess and suggest special investigations. Marked pulmonary symptoms, occurring in the course of malignant endocarditis, especially if it is right-sided, or in the course of septicæmic or pyæmic conditions, may also be indicative of abscess formation. The development of irregular fever, with leucocytosis, in the course of intrathoracic malignant disease, should suggest abscess formation.

It must, however, be remembered that the onset of pulmonary suppuration is not always acute and severe, and the course is not always markedly febrile. Such cases are liable to be overlooked, and are sometimes only revealed on routine X-ray examination.

The symptoms in pulmonary suppuration may be highly suggestive, and they repay careful study and analysis. In cases of acute abscess the patient may be extremely ill at an early stage, with severe fever and rigors. This is particularly the case with abscesses occurring in pyæmic conditions, and in some of the post-operative and other inhalation varieties.

In cases of chronic abscess, and especially after rupture has occurred, the fever is often irregular, and to some extent periodic. There may be a period with rising and persistent fever, with diminishing cough and expectoration, culminating often in sudden copious discharge of pus, followed by an apyrexial phase, or by a stage of slight intermittent pyrexia. Such a course usually indicates an abscess, opened into a bronchus but not draining effectively, with periodic retention and incomplete evacuation.

Cough is often paroxysmal and associated with copious expectoration, like that in bronchiectasis, and like that also in being brought on by change of position. A significant symptom, often first noticed by the patient, is an unpleasant taste, or a sensation of foul smell about the breath. This often precedes actual rupture by hours or days, and should always arouse the suspicion of abscess or interlobar empyema. Expectoration varies with the stage of the abscess. When there is sudden copious expectoration of pus, especially if signs of cavitation become apparent, the probability that there is an acute abscess which has ruptured into a bronchus is great. In chronic abscess the sputum approximates more to that found in bronchiectasis, and may separate, on standing, into the well-known three layers. It

is then usually offensive; in gangrene it is extremely foul, and large or small masses of necrotic lung tissue may be found in it. Hæmoptysis is a common symptom, occurring in 70% of the cases. It may be profuse, and may even be fatal, especially in gangrene. Pain is usually present, and is often very severe. Dyspnœa is usually marked in cases of acute abscess, but may be very slight in chronic cases. Rigors and profuse sweats may occur in the acute stage, but abscesses can certainly develop without either.

The physical signs in cases of abscess are often disappointingly slight and equivocal. They naturally depend upon the situation of the abscess. In cases of deep-seated or central abscess there may be none, unless the abscess has led to secondary bronchiectasis. At most there may be a localized area of dullness, with weak breath sounds, and possibly a few râles, due to the congested lung tissue around. In superficial abscesses, before rupture occurs, there may be dullness, with weak breath sounds, or signs suggestive of consolidation. When, after rupture and expectoration of pus, signs of cavitation develop rapidly, the diagnosis can be made almost with certainty. In cases of multiple abscess, consequent on septicæmic conditions, the signs may be those of disseminated patchy broncho-pneumonia. Clubbing of the fingers soon develops in cases of chronic abscess, probably in from six to eight weeks.

Radiological evidence is most valuable, and is often conclusive. It sometimes serves to suggest the diagnosis when the condition has not been suspected. It also helps to localize the abscess, and is indispensable where surgical treatment is invoked. The appearances are more characteristic in cases of chronic than in those of acute abscess. When rupture has occurred, the appearance of a fluid level in the cavity is most helpful in diagnosis, and for this purpose a photograph in the erect position should always be taken. In every case a strictly lateral radiogram should be taken, as well as an antero-posterior. This is often of greater assistance in localization than a stereoscopic skiagram, though the latter may be valuable.

The use of lipiodol is deprecated by some workers, on the grounds that it may carry infected material into bronchi lower down. Personally I find it useful in excluding other conditions, such as new growth and bronchiectasis. As a rule lipiodol does not enter the abscess cavity, the entering bronchus being usually obstructed by œdema, infiltration or pus. Occasionally a few drops enter the cavity, and are seen to vary in position with the position of the patient.

Blood-counts almost invariably show a leucocytosis up to 20,000 or 30,000 with relative polymorphonuclear increase. The leucocytosis persists after rupture, but often at a lower level.

Investigation of the sputum is valuable; when rupture occurs it may be almost pure pus. There is here also a marked polymorphonuclear preponderance. The various pus-producing bacteria may be found. Elastic tissue is almost always present and is theoretically of value in diagnosis from interlobar empyema. The presence of necrotic lung masses establishes the gangrenous nature of the process.

Bacteriological investigation may suggest the use of the arsenical compounds, when spirochætes, treponemata and anaerobes are present in addition to the ordinary pyogenic organisms.

Exploratory puncture should not be employed. It is dangerous, since it may lead to widespread infection of the pleura and of the needle-track, or it may precipitate rupture into a bronchus or into the pleural cavity.

Treatment: (1) Medical: The treatment should be medical in cases of acute abscess, at any rate until the suppurative process is localized by some reactive changes around it. It is now generally recognized that a notable percentage of cases, variously given as from ten to thirty, recover completely under medical treatment after spontaneous rupture. Naturally the percentage is greater in upper lobe abscesses. It is therefore desirable in most cases of abscess to give medical measures a trial. The patient in the acute stages is nursed, dieted and treated on

practically the same lines as in acute pneumonia. When rupture occurs, great care should be taken to turn the patient towards the affected side if possible, and to promote evacuation, since, with large abscesses, there is a risk of suffocation. The temperature often comes down, at any rate for a time, and it is possible to feed the patient more effectively. Expectorants may be given and various antiseptics, and deodorants like creosote, guaiacol, and syrup of garlic, when the expectoration is fœtid. Postural drainage or "tipping" is of great value and if the general condition permits, the patient should hang over the bed at least twice in the day and attempt to evacuate the cavity by coughing. Antiseptic inhalations are useful and are often comforting to the patient. The creosote vapour bath may be employed in cases which are afebrile or nearly so. Intratracheal injections are now less frequently employed than formerly, but may be considered. In gangrenous cases and those with very fœtid sputum, the use of some of the organic arsenic compounds, such as arsphenamin, sulpharsphenamin and salvarsan, may be used with benefit.

(2) Surgical: The decision to employ surgical aid is an important and a responsible one. Each case must be considered critically in regard to the time during which it is safe or hopeful to employ medical measures. As a rule, unless there is satisfactory and encouraging clinical and radiological evidence of progress towards cure within six weeks, it is wise to consider surgical intervention. On the other hand, if there are no signs of improvement after rupture, and if the cough and expectoration are exhausting, operation may be necessary much earlier.

In cases in which the abscess, though localized, does not rupture, surgery should be employed at an early stage, since there is the risk of the abscess becoming chronic with very thick walls and therefore less likely to cicatrize up after it is opened.

In localized gangrene, the best chance for the patient may be in early operation. In cases of multiple chronic abscesses, surgery is usually necessary, especially if the abscesses are close together. In cases of chronic abscess leading to secondary bronchiectasis, surgical intervention should not be delayed. This development is a calamitous addition to the patient's difficulties and should if possible be prevented. Surgical treatment is also necessary, often urgently so, in cases of superficial abscess which rupture into the pleura.

There are numerous surgical methods now recommended and the decision must be a matter for free and frank consultation between the physician and the surgeon. I shall here only enunciate the chief of these methods and briefly express my opinion and my experience. Bronchoscopic evacuation is clearly only suitable for cases in which rupture has occurred and where there is a more or less open bronchus. It may certainly be of value in cases due to inhaled foreign body or septic material.

Thoracotomy, with evacuation of the abscess and subsequent drainage, is, in my experience, the most generally useful and successful, if employed at the right time. It should be recognized that in most cases it may be of necessity a two-stage operation, the preliminary stage being necessary to ensure adequate pleural adhesion about the area of lung where the opening is to be made. Adequate drainage is an important factor and I hope to hear from the surgeons as to the value of early packing with gauze before the use of a drainage tube.

Collapse Treatment.—(a) Artificial pneumothorax has been recommended, more especially in deep or centrally situated abscesses, after rupture into a bronchus has occurred. Though theoretically an admirable method of treatment, I regard it as dangerous and undesirable for the following reasons: First that if there are extensive pleural adhesions, the collapse of the lung, and therefore the emptying of the abscess, are liable to be incomplete, and secondly that there is grave danger of rupture into the pleura. Curiously enough, this serious accident occurs more commonly when re-expansion of the lung is being allowed. Although a considerable proportion of cases recover from this after operation, it is a risk to which I am not prepared to submit my patients. (b) Thoracoplasty may have to be considered in cases of

large chronic abscess, or of multiple abscesses, especially if there is secondary bronchiectasis. With early diagnosis and with effective treatment, such cases should be rare.

Phrenic evulsion is frequently of value. There are three chief indications for its use: (i) When an abscess has evacuated spontaneously but when drainage is slightly incomplete, owing to the relation of the abscess cavity to the bronchial opening. The rise in the diaphragm after phrenic evulsion may be all that is necessary to permit gradual closing of the abscess. (ii) When secondary bronchiectasis is developing, owing to cicatrization and the resultant drag on adjacent bronchi. Here the ascent of the diaphragm may relieve the drag and prevent dilatation. (iii) As a preliminary to thoracoplasty if such proves to be necessary.

Lobectomy may occasionally be the method of choice, when a lobe or a portion of a lobe is disorganized by the abscess and its effects. The mortality of this operation is diminishing with improving technique, but I hope that, as with thoracoplasty, the need for its employment in cases of abscess will become rare.

Complications and sequelæ.—For the most part these are surgical, but they must be borne in mind. They include empyema and severe infection and infiltration of the chest wall after operation. The conditions of bronchial fistula and "lattice lung" may also result after operation and require surgical treatment.

Septic bronchopneumonia and cerebral abscess are two grave and disappointing complications, which at present we seem powerless to prevent.

Mr. John Hunter: Intrapulmonary suppuration may occur as a single abscess or as multiple abscesses: I propose to discuss only the single abscess, which forms without dilatation of the bronchi, so as to exclude those abscesses occurring in bronchiectasis. Lung abscess appears to be more common in men than women and much more common in the lower lobe of the right lung than in the left lung.

It is customary to regard abscess of the lung as acute, subacute, or chronic. The more acute cases are of a gangrenous type. The acuteness or chronicity of the case will depend on a large number of factors viz.: the patient's resistance, the virulence of the organisms, the position of the abscess and so on. This classification of an abscess is not so important from the point of surgical treatment as the question of whether the abscess is closed or open, a closed abscess, generally speaking, calling for more urgent surgical intervention than an open one that is draining into a bronchus. The diagnosis of lung abscess will depend on the history and symptoms, the signs present, and the radiological examination.

The onset is commonly abrupt, and may be heralded by rigors and severe constitutional disturbances, or with a less severe type of temperature, and a feeling of general malaise. In the majority of cases there can be elicited a history of a lung disease such as pneumonia, or of an operation, frequently in the oral region. In all cases there will be a cough, associated with sputum varying in character and amount, depending on the type of abscess present, on the amount of lung tissue involved in the breaking-down process, and the surrounding consolidation. This sputum may vary from a mucoid to a thick heavy dark type. In the acute cases there is blood staining, the blood usually altered in character. The sputum, although copious, may not be foul in character, the characteristic sweet foul odour being only present when the abscess is draining into a bronchus. The sputum is frothy and on standing settles into layers, but this is only true if the cavity is an open one. The patients look ill and have a raised pulse and temperature but not necessarily increased respiration rate. Signs of cavitation will be present, depending on whether the abscess cavity is completely or incompletely filled with pus.

The radiological appearances are most helpful. A shadow will be seen in the affected lobe, perhaps circular in outline, or it may be triangular, the point directed towards the mediastinum. This shadow is towards the periphery in the majority

of cases, there being a clear area between the shadow and the mediastinum, or if not a clear area the density of the shadow is less towards the mid-line. In the open abscess a fluid level will be seen, the upper circular edge of the shadow representing the consolidated lung surrounding the cavity. In rare cases a fluid level is seen in a closed abscess owing to the presence of gas-forming organisms. I have stressed the importance of this peripheral shadow, as it is one of the chief characteristics of a typical lung abscess, and has some bearing on the treatment. The use of lipiodol in the diagnosis of lung abscess is of little value in showing its extent, as in the majority of cases the lipiodol runs into the surrounding bronchi and not into the cavity. The cause of this is either the valvular nature of the opening, due to granulation tissue, or the fact that the opening faces downwards. In cases in which there is some doubt as to the cavity being due to a breaking-down carcinoma, lipiodol helps by showing up the block in the bronchus. Diagnostic needling of the lung should never be performed, as it is impossible to tell whether pleural adhesions are present or not, and if the needling takes place across a free pleural space there is grave danger of a pyothorax ensuing.

In the treatment of lung abscess it cannot be too clearly emphasized that a considerable number of cases will get well without external operation. This is seen most frequently in abscess of the upper lobe, and this must be considered a fortunate occurrence, as in my experience that is the most unsatisfactory type to treat surgically. In speaking of these cases that are cured by non-operative treatment two conditions must be present to warrant its attempt: these are that the abscess must be draining freely into a bronchus, and that the abscess is an acute one, as shown by the history and amount of consolidation in the lung surrounding it. Valuable help may be given in these cases by judicious bronchoscopy under local anæsthesia.

Failure to produce improvement by postural treatment and drainage will necessitate more active measures. The question will either arise, or may have already been considered, as to collapse of the lung by producing an artificial pneumothorax. This method necessitates a free pleural cavity if success is to be hoped for, and therefore must frequently fail in cases in which the abscess is in the extreme periphery, owing to pleural adhesions. Two complications may arise in this treatment; firstly, obstruction of drainage with considerable increase of the patient's symptoms, and secondly, the production of a pyopneumothorax. The latter is, naturally, a serious matter but I have recently taken a less grave view of it than I did, and I think in a certain number of cases the proper management of the empyema may be followed by cure of the abscess of the lung. I have recently had two cases, in which abscesses were draining well through a bronchus, develop empyemata, which were kept under control with aspiration for a period, and then drained, with the subsequent apparent cure of the abscess.

The above methods apply only to the open abscess. When these have failed, or when the abscess is a closed one, thoracotomy and drainage are indicated. When this has been decided upon, accurate localization is essential, and for this purpose two fresh radiograms should be taken, one an antero-posterior view and the other a true lateral, these, together with the clinical signs, will give the most accurate information as to the point at which the abscess is closest to the chest wall. The approach to be used will depend on the position of the abscess, the upper lobe abscess being drained through an incision in the upper part of the axilla or the front of the chest, the lower lobe abscess being reached through a postero-lateral incision. A portion of the appropriate rib is removed and the parietal pleura incised; the presence or absence of adhesions is at once seen, and will determine the subsequent procedure. If adhesions are present the one-stage operation can be performed. The lung is palpated and the presence of the abscess can frequently be determined by a feeling of consolidation, and it is my practice to remove further portions of ribs in the immediate neighbourhood in order to allow adequate collapse when the abscess

is opened. An exploring needle is then introduced into the consolidated area until the cavity is found. It is nearly always possible to feel the needle passing through the wall into a free space, before pus is withdrawn. In some cases no pus is found and one is content with withdrawing a syringeful of foul gas. The needle is left *in situ* and the cavity opened along it either by a knife or cautery, sufficient lung tissue being removed over the abscess to allow adequate drainage; there is surprisingly little bleeding, owing to thrombosis in the consolidated lung. The cavity is carefully explored with the finger and further extensions of the abscess are sought for, and if present, gently opened up. If large vessels are found crossing the space, these should be clamped. A large tube is introduced into the cavity and a light gauze packing placed round it; this packing is left *in situ*, and removed on the second or third day; if left longer it may promote further fibrosis in the wall of the cavity and so prevent efficient collapse. The tube and gauze are brought out of the wound and the wound is partially sutured.

If pleural adhesions are not found, either the lung must be sewn up to the parietal pleura, or gauze introduced to form adhesions, the abscess being opened at a subsequent period—not earlier than five days; and the wider rib resection being left till this period, because, as Hedblom has pointed out, patients can thus cough more easily during the waiting period. My experience has been that the number of cases in which the two-stage operation has been necessary are very small. I have found that in the case of a free pleural cavity my localization was at fault and that, on introducing a finger, the lung was found to be adherent at a higher level, which allowed me at a subsequent procedure to drain the abscess without the production of further adhesions.

The choice of anæsthetic is of considerable importance. It is to be remembered that we are dealing with an already damaged lung and that manipulation is liable to spread infection; further, although it is a rare accident, a large abscess may burst into a bronchus during the operation and drown the patient. Some form of non-irritating anæsthetic is necessary, together with a means of raising the intratracheal pressure. I have found gas-and-oxygen preceded by avertin the most satisfactory.

The immediate effect of open drainage is a marked improvement in the comfort of the patient; his cough is greatly lessened, he very shortly regains his appetite which in most cases has been impaired by the foul sputum, and within a few days the temperature and pulse begin to settle. The tube drainage is kept up as long as there is any significant discharge and stopped when the discharge ceases, and the wound is then allowed to granulate from the bottom. The usual result, as seen on X-ray examination, is the clearing of the shadow and after a period some fibrous tissue only shows where the abscess was.

The persistence of a bronchial fistula after operation is, in my opinion, due to inadequate collapse of the chest wall at the time of operation, and will require further operation to allow more local collapse.

Two complications of pulmonary abscess must be mentioned—secondary bronchiectasis and abscess of the brain. The cause of the former is obstruction to the flow of secretion from the distal tubes, together with unequal contraction taking place in the lung owing to fibrosis. In the chronic abscess that has not had surgical treatment both these factors play a part, but in cases in which drainage has been performed the unequal contraction of the fibrous tissue is the chief cause, and, as in the case of bronchial fistula, is due to inadequate collapse of the chest wall, and when present is extremely difficult to treat, requiring in many cases a paravertebral thoracoplasty. Abscess of the brain is a dreaded and usually fatal complication; its incidence, in my experience, is less in abscess of the lung than in bronchiectasis. Whether it is more common in cases operated on than in those which have had no surgical interference, I do not know, but the danger of its occurrence should always be kept in mind when palpating a lung which is the seat of a suppurating process.

The ætiology of lung abscess must be mentioned when discussing the treatment, because it may be possible to prevent its occurrence in the first place. Apart from the breaking-down of a pneumonic process, the infection may reach the lung from the bronchus and by the blood-stream. Infections by the respiratory tract appear at first sight the most obvious, especially when we consider the frequency with which lung abscess follows operations about the oral and pharyngeal cavities, presumably due to the aspiration of septic material, yet numerous observers have failed experimentally to produce lung abscess by this route, not that that necessarily proves the point, as experimentation is as likely, if not more likely, to err than clinical observation.

FIG. 1.

FIGS. 1 and 2.—Showing necrotic areas occurring in the periphery of rabbit's lungs, produced by septic emboli. The tense hyperæmia surrounding these patches can be well seen.

Infection by the blood-stream presumes the presence of an embolism arrested in the capillary bed of the lung, producing a local suppuration.

My own view is that probably both the respiratory tract and embolism play their part. During operations in the oral and pharyngeal cavities the patient is receiving a volatile anæsthetic, and the field immediately after operation is submitted to most violent movements, associated with vomiting, swallowing, and straining, so that it would be surprising if small venous clots were not expressed into the blood-stream. If this is so, these emboli are arrested in the lung at a time when the action of the anæsthetic is still active. Lister showed many years ago

that a volatile anæsthetic had a marked paralysing effect on the action of cilia, and we may presume that during anæsthesia, and immediately following it, secretions are retained in the terminal bronchi until the cilia recover and pass them on, these secretions being possibly heavily infected. Under these circumstances an embolus lodged in a peripheral vessel, where the blood-pressure is very low, may well produce sufficient damage to the parenchyma of the lung to allow an infection to take place and so produce a lung abscess; it is not necessary that the embolus should be infected, as the organism may well come from the respiratory tract.

Some years ago I attempted to produce lung abscess in rabbits by introducing into their tracheas a few cubic centimetres of lipiodol, mixed with ground glass—in

FIG. 2.

order to produce some trauma—and infected with staphylococci; in no case was I successful. I then introduced 0·3 c.c. of lipiodol mixed with a loop of staphylococci into the vein of a rabbit's ear. In all cases I was able to produce a lesion in the lung, these were all in the fringe of the lung, that is peripherally, and varied from grey patches to a typical abscess, with a localized empyema in its neighbourhood (see figs. 1 and 4).

I therefore believe that a large number of abscesses are due to a combination of embolism and volatile anæsthesia, and that if some means can be found to prevent emboli occurring as I have described, and an anæsthetic other than a volatile one be used, the number of cases of abscess of the lung will be greatly diminished.

FIG. 3.—Showing a single abscess in a rabbit's lung. Thickened visceral pleura can be seen over the abscess where this was adherent to the parietal pleura.

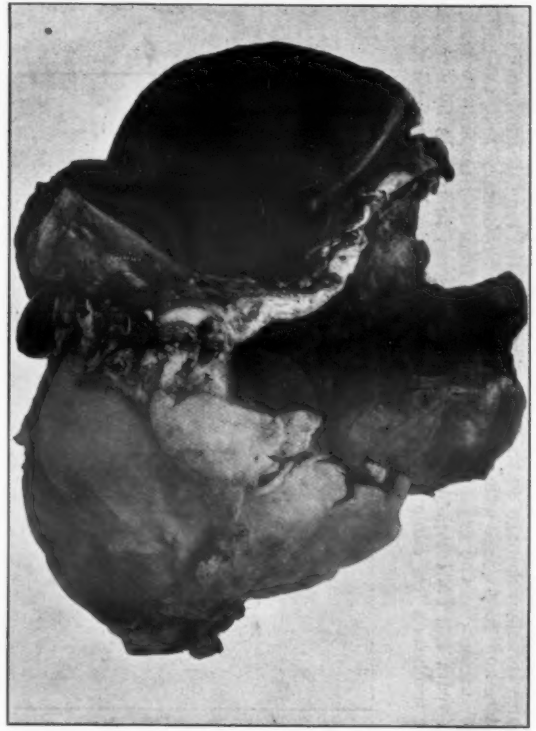

FIG. 4.—Rabbit's lungs showing a large empyema produced by extension from a small peripheral abscess.

Dr. James Maxwell: The term "lung abscess" is used to cover a number of different conditions, some of which differ remarkably in their pathology. There is no agreement in classification, but for the purposes of the present discussion it will be taken that there are three main types. Firstly, there is the circumscribed abscess, secondly, gangrene, and thirdly, a diffuse suppurative condition which may affect one or more lobes. Kline [1] considers that lung abscess is usually staphylococcal in origin and occurs chiefly in children, whereas gangrene is the result of infection with spirilla and fusiform bacilli and occurs chiefly in adults; he lays considerable stress on the bacteriological findings in the sputum for the distinction between the two conditions. Other observers, however, do not appear to make use of this distinction, and on the whole it does not appear to be of great practical importance. For present purposes it will be taken that abscess is a definitely inflammatory condition, whereas gangrene is the result of a necrotic process, usually the result of interference with the blood supply of the lung.

In the diagnosis of these conditions the main clinical stress should be laid on history and symptomatology. Physical and X-ray examinations are helpful, but their main function is to localize the lesion, once it has been diagnosed. The history varies considerably in different cases, according to the cause of the abscess, and consequently the chief factors concerned must be borne in mind, otherwise the presence of an abscess may be overlooked. Perhaps the commonest cause of lung abscess is an extension of the inflammatory process, with suppuration, in lobar or broncho-pneumonia, but another common cause is thought to be the aspiration of infected material from the upper respiratory tract. Consequently lung abscess is a potential complication of any operation performed under a general anæsthetic, and most particularly of tonsillectomy and other operations performed on the nose, nasopharynx and mouth. It has even been known to follow such operations as dental extraction performed with a local anæsthetic, although it is far commoner when a general anæsthetic has been employed.

The early symptoms on which stress should be laid are cough, pain in the chest, and the general symptoms of profound toxæmia. Rigors, fever, sweats, and tachycardia are the rule, and the respiration-rate is increased although there is not as a rule, dyspnœa. Cough may be paroxysmal from the beginning and, although there may be no sputum, the breath is usually notably offensive. Hæmoptysis is not common in the earlier stages, although when pus is being coughed up it is often mixed with altered blood. Consequently when the symptoms previously detailed occur in a patient who has one of the predisposing causes already considered, the presumption of the presence of a lung abscess becomes so strong as to be almost a certainty.

A third less common, but no less important, group consists of those cases in which the abscess occurs distal to a growth, and any case of apparent lung abscess in a middle-aged individual must always be considered suspicious and steps must be taken to exclude the possibility of growth unless there be a clear indication of some other cause for the abscess. Less commonly there may actually be a foreign body in the bronchus, but this will usually be clear from the history, except in the case of young children in whom this possibility should always be borne in mind, even in the absence of any direct history of inhalation.

The physical signs are usually ambiguous. In the more acute types they may be similar to those of pulmonary consolidation, interlobar effusion, or cavity formation of any kind; occasionally, even with quite large abscesses, there may be no physical signs at all. In the more chronic uncomplicated cases the signs vary according to the content of the cavity. The percussion note may be normal, tympanitic or impaired, and there is usually a variety of added sounds. It will be seen, however, that there is no single sign which is pathognomonic of lung abscess as opposed to other forms of cavity, pulmonary consolidation, or localized effusion. The diagnosis

from physical signs becomes still more difficult when we realize that by the time they come under observation many of these cases are already complicated by pleural effusion which may be either clear or turbid, or frankly purulent. It must be remembered that in any case in which pus is found in the pleural cavity and in which there is no clear history of previous pneumonia, there is most likely to be an underlying lung abscess or growth. It will be seen, therefore, that physical examination gives little clue to the exact nature of the pulmonary lesion, the main guide in this case being the history and symptomatology. Once, however, the presence of a lung abscess is suspected, physical examination is, of course, of primary importance in establishing the site of the lesion, and consequently in guiding a decision as to what form of treatment is best suited to the needs of the particular case.

Further and most valuable assistance in localization may be obtained from skiagrams of the chest. It is essential that there should be not only antero-posterior, but also lateral, or preferably oblique, views. In the more acute cases screening shows that there is deficient movement of the diaphragm on the affected side and a dense irregular shadow with an indefinite outline. Later on, the centre of this shadow becomes less dense but it is unusual to see a fluid level at this stage. In the more chronic cases the shadow is circular and much more regular, and may show a fluid level. In doubtful cases this fact may be confirmed by skiagrams taken in the erect and supine positions. Lipiodol investigation is of little value in making the diagnosis, although occasionally it may be helpful in accurate localization. In the great majority of cases lipiodol does not enter an abscess cavity, although, if free drainage into a bronchus be established, complete filling may result; lipiodol is occasionally valuable in suggesting the possibility of the presence of a growth.

From the diagnostic point of view, little assistance is usually obtained from the bronchoscope, the chief conditions in which it is of value being growth, bronchiectasis and the presence of a foreign body.

The chief conditions from which lung abscess has to be differentially diagnosed are localized empyema, carcinoma, consolidation and bronchiectasis. If adequate attention is paid to the history and symptoms, there should be little difficulty, even in the presence of physical signs which may be equivocal.

The treatment must vary with the cause, site and acuteness of the condition. It may be taken that in all cases expectant treatment should be adopted unless there is some strong indication to the contrary. Spontaneous healing is not uncommon and it seems probable that in many cases of apparent delayed resolution in pneumonia, small abscesses may form, burst, and heal without ever having been diagnosed at all. It should be remembered that in experimental animals it is difficult to produce lung abscesses which tend to spread. As a rule, septic material introduced into the bronchi is dealt with by a healthy respiratory tract without progressing to the stage of chronic lung abscess, and Weidlein and Herrmann [2] were only able, as a result of the introduction of septic material into the systemic veins, to produce small abscesses which healed spontaneously within three weeks.

The most important factors in the expectant treatment are, firstly, rest in the more acute stages—to encourage localization of the abscess as far as possible—and secondly, postural treatment. The latter treatment is comparatively simple when the abscess is situated in the upper lobe, and if persevered in is very frequently rewarded with success. An abscess in the lower lobe is more difficult to treat by this means, from the mechanical point of view, yet even in such cases with adequate treatment, the patient being kept in an almost inverted position for as long as possible at frequent intervals, the abscess may discharge into the bronchus and a spontaneous cure may result.

Other medical measures which may be adopted are those commonly employed in the treatment of any infective process. Poultices, simple inhalations and diathermy all have their uses, although the part which they play is admittedly of minor

importance. Quite recently, favourable results have been claimed from intratracheal medication, various antiseptics such as 10% gomenol in olive oil, argyrol, and even lipiodol, having been employed for this purpose.

The uses of the bronchoscope in diagnosis have already been referred to; in treatment, however, it has a much more important rôle. Apart from the question of the removal of a foreign body, the bronchoscope may be used for establishing drainage in cases in which the abscess is shut off from the bronchus, but its use is limited to those cases in which the abscess is situated in the lower and central part of the lung.

Medicinal treatment is of very little value. It is stated that emetine given empirically is sometimes attended with success, and the organic arsenical preparations have been used when bacteriological examination of the sputum has shown evidence of infection with spirilla. A question of great importance is as to the duration of non-surgical efforts to bring about a cure. It is obvious that every case must be taken on its merits, but, as a general rule, when no improvement is manifest after a period of eight or ten weeks of adequate treatment on the lines indicated, surgical intervention should be seriously contemplated. The lines of surgical treatment, again, vary according to the situation and state of the abscess. It seems clear that the induction of artificial pneumothorax should not be considered as a method of choice, except possibly when the abscess is deeply seated and is draining freely into the bronchus but is not showing signs of healing. Artificial pneumothorax, induced when free drainage is not established, may do more harm than good, and when the abscess is situated close to the periphery of the lung, the danger of such complications as pyopneumothorax, chronic empyema, and bronchopleuro-cutaneous fistula, is so great as to contra-indicate this line of treatment. It is not my purpose to discuss the more strictly surgical treatment. As a rule phrenic evulsion has no effect on the condition and the operation of choice is drainage of the abscess. This, of course, should not be performed when there is a free communication with the bronchus. When the abscess is draining freely through the bronchus and yet is showing no signs of healing up, considerable success frequently attends the performance of thoracoplasty either partial or complete; it is better in such cases to perform a large—rather than a small—operation, to ensure a successful result.

References.—[1] KLINE, B. S., *Journ. Amer. Med. Assoc.*, 1928, xc, 2008. [2] WEIDLEIN, I. F., and HERRMANN, L. G., *Journ. Amer. Med. Assoc.*, 1928, xci, 850.

Dr. Peter Kerley: Within the last ten years our ideas on the symptomatology, pathology and treatment of lung abscess have undergone considerable alteration. Diagnosis and localization are more accurate, and medical and surgical procedures are more effective. Chest radiography has played a big part in these advances. X-ray examination is absolutely essential for the localization of a lung abscess, but beyond mentioning that lateral views are of far more help than stereoscopic views, I shall not deal with this aspect of the subject to-night.

The diagnosis of lung abscess is by no means simple; the clinical findings vary enormously, and the common impression that a skiagram sooner or later shows a round opacity with a fluid level is quite erroneous. Abscess of the lung is a comparatively rare disease and owing to its rarity we are only incompletely acquainted with its manifold radiographic appearances.

The X-ray appearances of lung abscess vary according to the method of infection, the nature of the infection and the reaction of the surrounding lung tissue. The method of infection is of paramount significance, the nature of the infection and the local pulmonary reaction only altering the picture slightly. This applies only to the common forms of lung abscess and not to fungoid or malignant infections.

The frequency with which small pulmonary emboli are now diagnosed *in vivo* casts great doubt on the old pathological theories of lung embolism which are all based on Virchow's work. It is impossible to state definitely whether septic embolism or aspiration of infective material is the common cause of lung abscess, but if our ideas of living pathology, interpreted from skiagrams, are correct, septic embolism is the more frequent.

A small pulmonary embolism, lodging in an otherwise healthy lung, invariably produces a round, well-defined opacity somewhere in the periphery or in the middle of the lung. The typical wedge-shaped infarct of the pathologists is not seen *in vivo* because the production of an infarct of the wedge shape necessitates obstruction of a large vessel and this occurrence nearly always causes fatal shock.

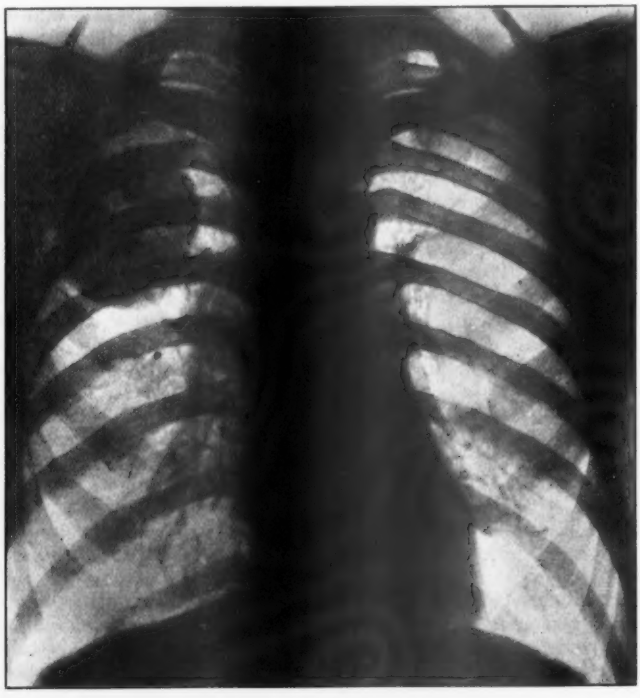

FIG. 1.—Embolic abscess in the right upper lobe.

An embolic lung abscess therefore, seen in its early stages, appears as a round, sharply defined, homogeneous opacity (fig. 1). It has been shown by post-mortem examinations that only the centre of this opacity is infected, the outer two-thirds being produced by non-infected consolidation. There is no fluid level in the opacity and no inflammatory reaction in the lung tissue outside the embolized area. The spread of the infection from the centre to the periphery may take a few days, or it may take weeks. If the infection spreads rapidly, a sharp reaction, visible as a hazy opacity, develops round the abscess, but this hazy opacity is rarely thick enough to obscure the dense central opacity. A fluid level does not appear until the abscess has spread

to the periphery of the embolic area and ruptured into one of the bronchi. Weeks may elapse before a fluid level can be seen, and the patient may die from pyæmia without ever having coughed up purulent sputum. It is obvious that at the beginning of the disease the bronchioles supplying the infected area are completely blocked by the solid zone around the necrotic centre.

No air can reach the affected area and no pus can escape from it until the necrosis has spread to the edge of the solid zone and into a large bronchus. In many cases hæmoptysis precedes expectoration of purulent material. If the organisms responsible for the abscess are gas-forming, a fluid level may be seen before rupture into a bronchus has occurred. Fortunately infection of this nature is rare. The nearer an embolic abscess is to the pleura, the greater is the danger of a complicating pleural effusion or empyema. It is doubtful if a subpleural embolic abscess can provoke an empyema without actual rupture of the abscess into the pleural cavity, but the possibility of a serous effusion accompanying an abscess must be borne in mind. The presence of both conditions can only be diagnosed by hard pictures taken on a Potter-Bucky diaphragm.

Several workers have noted that lung abscesses, when round and sharply defined, sometimes double or treble in size within from twenty-four to forty-eight hours. No one has offered an explanation for this phenomenon; I believe it to be due to a second embolus lodging in close proximity to the first. In all the cases of mutiple emboli and abscesses which have come under my observation there was a definite tendency for the emboli to lodge in the same area. In only one case have I seen multiple abscesses scattered apparently haphazard through the right lung.

Radiography is the only means by which multiple abscesses can be diagnosed, and even this is not as simple as it sounds. Usually two or three embolic abscesses are surrounded by a common zone of œdematous lung tissue and, because of this, only one fluid level may be visible in the upright antero-posterior view. This gives the impression that there is only one abscess present, but if a skiagram is taken with the patient lying on the diseased side, multiple fluid levels become visible. The importance for the surgeon of demonstrating multiple fluid levels is obvious.

The X-ray appearances of an aspiration abscess (fig. 2) differ in many ways from those of embolic abscess. An aspiration abscess is usually single and practically always in the right lung. It is seldom found near the periphery of the lung, but tends to develop near the mediastinum or the hilum. It is not sharply defined in its early stages and, when first seen, appears as a vague ill-defined opacity which becomes denser and sharper in outline as it becomes chronic. On the other hand, an embolic abscess may develop in any part of either lung. It is usually seen near the periphery, or in the middle, of either lung, and, unlike the aspiration abscess, it is sharply defined to begin with, and only becomes vague and ill-defined as the infection spreads to the periphery of the embolized area.

The pathological foundation underlying these appearances is easily appreciated. The anatomy of the bronchial tree explains the predilection of aspiration abscess for the right lung, because the angles of the main bronchi predispose to infected material running into the right lung.

The introduction of any foreign material into the bronchi sets up reflex spasm of the bronchioles, which immediately contract and effectively prevent the foreign material from being carried deep into the lung. This fact explains the constant proximity of aspiration abscess to the larger bronchi and the hilum.

Infected material, lodging in the bronchi, produces an immediate reaction with congestion of—and exudation into—all the alveoli supplied by the affected bronchi; this congestion and exudation cause the vague, ill-defined opacity of early aspiration abscess. It is usually possible, however, to differentiate between the congested lung tissue and the suppurating lung tissue, without the injection of lipiodol. As the lesion becomes chronic, the suppurative process spreads into the congestive process,

and while this is happening, nature is establishing a protective zone of fibrous tissue around the abscess. When this protective zone is firmly established a round capacity, identical with that seen in early embolic abscess, appears.

Lipiodol rarely runs into an abscess, but a lipiodol injection should always be made. In many cases there is bronchiectatic dilatation outside the true abscess, and the demonstration of such bronchiectasis is an important consideration in treatment.

The differential diagnosis may be exceedingly difficult. Excluding benign tumours and hydatid cysts, the conditions which may simulate lung abscess radiographically are interlobar empyema, bronchial carcinoma, tuberculosis and syphilis. An interlobar empyema may resemble either an embolic abscess or an

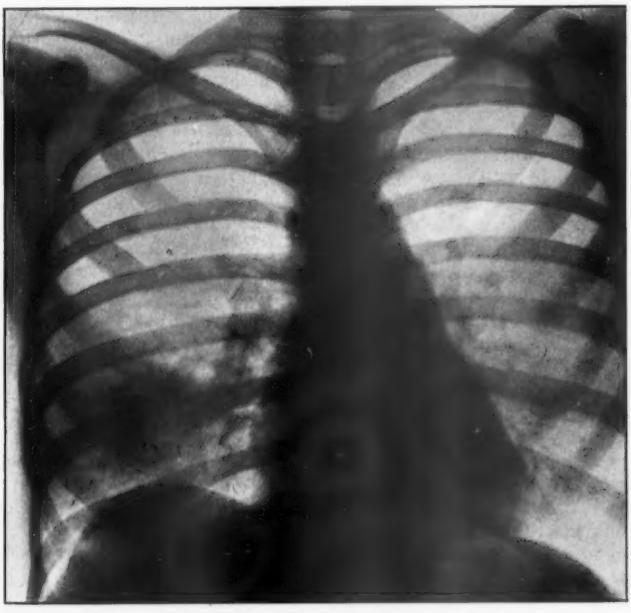

FIG. 2.—Aspiration abscess in the right lower lobe.

aspiration abscess, and the differential diagnosis depends entirely on the lateral view.

Abscess in an area of collapsed lung tissue distal to a bronchial carcinoma is also a source of error, but the asymmetry of the abscess to the solid lung tissue and the demonstration of bronchial stenosis by a lipiodol injection are characteristic findings.

Early infraclavicular tuberculosis often gives X-ray appearances identical with those of embolic abscess. Any round opacity in the infraclavicular region should be treated as tuberculous unless there are typical symptoms, such as purulent expectoration. Pyrexia is of no value in differentiating between the two diseases. Skiagrams taken at intervals of fourteen days will usually solve the problem; if the shadow is

tuberculous little or no change will have taken place in that time, while if it is an abscess there will be considerable alteration.

On three occasions I have seen an unusual form of tuberculosis following abdominal operations in young people. In all three, the X-ray appearances resembled lung abscess, a large cavity with a fluid level being visible near the hilum. All three had abundant tubercle bacilli in the sputum, but in the absence of this finding, the diagnosis can be made by the fact that the fluid level in a tuberculous cavity does not change with posture. The surface tension of sputum is high and it takes a considerable time to find its level. Syphilis of the lung is rare, but its possibility should be borne in mind in cases with a history of long-standing chronic abscess.

Mr. V. E. Negus : *Bronchoscopic treatment.*—For the purpose of these remarks by "lung abscess" is meant a localized collection of pus in the lung, either in the parenchyma, or in a bronchus whose walls have broken down. The infection may have entered by the blood-stream or the lymphatics, or else through the trachea by inspiration of infected material. In some cases the patient coughs up a quantity of sputum, but in others the cough is unproductive because the collection of pus is not in communication with a bronchus, or because the bronchus leading to the abscess is obstructed.

Indications for bronchoscopy.—From the results obtained there seems no doubt that a bronchoscopic examination should be made in every case of lung abscess. It is impossible to tell what good can be done without this perfectly harmless procedure as a means of diagnosis. Local anæsthesia is used almost invariably.

Parenchymatous abscess not communicating with a bronchus.—If the patient has little or no sputum, the reason may be that a bronchus is blocked, and can be freed, or there may be no communication with the abscess. In the latter case direct inspection reveals more or less normal bronchi, without obstruction to the lumen and without exudation of pus from branches. Flexible suction tubes slightly or fully curved are passed through the bronchoscope down the various branches, to determine whether pus can be aspirated. If the result is negative, the case is unsuitable for bronchoscopy and must be treated by other methods.

Communicating abscess with blockage of bronchus.—It may be found on bronchoscopy that a main lobe bronchus, or a branch, is blocked by swelling of the mucous membrane or by granulations. The appearance is quite obvious, as no lumen can be seen, no pus escapes, and no air passes to produce bubbles in the secretions.

In one such case blockage of the right lower lobe bronchus was overcome at the third examination by the use of a flexible aspirating tube; much pus, mixed with a quantity of blood from the granulations, escaped, and the sputum subsequently became copious. It was hoped to produce great improvement, but after six bronchoscopic treatments, in spite of lowering of the temperature and pulse and slight raising of the weight, the patient did not feel much better, and therefore he was referred for operative treatment.

After a fair trial, bronchoscopic treatment should not be continued over-long if no definite improvement is obtained.

In another case the right lower lobe bronchus was blocked by thick secretions; the patient had undergone prostatectomy, and had suffered during five weeks from fever of a hectic type. A single bronchoscopy unplugged the bronchus, after which the patient gradually recovered and regained his health.

In a third case the abscess appeared to be on the course of the first dorsal branch of the right lower lobe bronchus; six bronchoscopic aspirations with a sharply curved flexible tube did not drain the pus, and external operation was necessary.

Communicating abscess with poor drainage.—In many cases the patient brings up large quantities of sputum, often offensive, but fails to empty the cavity even after postural coughing. Bronchoscopic examination reveals swelling of the walls of

one or other bronchus, associated with granulations. Pus is seen oozing, but when a flexible tube is passed, more secretion is aspirated. The reason for absence of spontaneous cure is that the narrowed bronchial lumen is completely closed during cough, and sometimes even during expiration. The rhythmical respiratory movements may be watched, and direct observation shows that inspiratory dilatation allows some air to enter the lobe, but that active closure during expiration or cough closes the lumen and imprisons pus in the distal cavity. The harder the patient coughs, the less, in fact, will he get out.

With a bronchoscope in position, the bronchial walls are held open, and stagnant residual pus is aspirated as from a sump. The patient's cough, purposely unobliterated by cocaine, brings up more secretion from the lung area which drains through the abscess into the bronchus, from which it is pumped away. After aspiration of all remaining pus, and dilatation of branches of the bronchus with a fine tube with a flexible end, granulations are painted with silver nitrate solution of 10% strength. Irrigation appears to do more harm than good, and the introduction of antiseptics seems to be devoid of any useful result. One patient with a year's history of so violent a cough and such foul sputum that he vomited after each meal, was cured after eight bronchoscopic treatments, and now, five years later, is passed A1 as a naval reservist. The condition was ascribed to influenza associated with peritonsillar abscess.

Another severely ill patient had thirty-four branchoscopic treatments for a large abscess cavity communicating with the right middle lobe bronchus ; he improved very much at first, but relapsed and required external operation.

One man who had coughed up purulent sputum for four weeks after pneumonia and had sweating, fever, and dyspnœa, recovered after six bronchoscopies and is now in good health, and able to play tennis. He had profuse granulations partially obstructing the main right lower lobe bronchus.

Two groups of cases must be considered separately: (1) Abscesses following operations, and (2) abscesses caused by a foreign body.

(1) In post-operative cases the results to be obtained are extremely good. Cure may be expected in the majority of cases, even though a considerable interval has elapsed before the commencement of bronchoscopic treatment. The experience of other observers thoroughly confirms this conclusion.

Six patients come within this category. Three had teeth removed to the number of eighteen, twenty and twenty-eight, all under a general anæsthetic ; in two instances bronchoscopic examination was asked for because it was supposed that a piece of tooth was in the lung. No solid foreign body was found, but the patients were cured. The abscess no doubt followed the inspiration of an infected clot, with subsequent local inflammation and the formation of granulations in the bronchus, associated with the breaking down of the walls ; removal of the clot or its results by aspiration, dilatation, and the application of silver nitrate led to cure. These three patients had suffered from sweating, high fever, and dyspnœa for periods of four weeks in two instances, and for two years in the third ; medical methods of treatment had of course been tried, but without improvement. After intervals of six, four and two years, all three are in good health.

The fourth patient, after total laryngectomy, had high fever and signs of commencing gangrene of the lung. The abscess formation was cured by one aspiration, but the patient unfortunately died some months later from recurrence of carcinoma.

The fifth patient has been referred to already, as suffering from plugged bronchus after prostatectomy.

The sixth patient had been ill for eight months after tonsillectomy. He was improved by six bronchoscopic treatments but was not well, and external drainage was required to cure him.

(2) If the abscess is caused by the presence of a foreign body, and if the latter is removed, the patient will get well. Several of those referred to in this series were desperately ill, but all were cured. Eight cases come under this heading. Six patients were known to have foreign bodies in the lung: (i) a screw for seven weeks, (ii) an orange pip for four weeks, (iii) a tooth for four weeks, (iv) a tooth for about two weeks, (v) a glass bead in position for four weeks, and (vi) a glass bead in position for three months. In two others the presence of the inhaled object was discovered only by bronchoscopy; in an infant, some fragments of nut from milk chocolate, and in a man a complete vertebra of a rabbit *in situ* for sixteen months, were found and removed. This last patient required two bronchoscopic examinations before the foreign body was recovered and removed, and nine subsequent treatments to drain the abscess. He has now been at work constantly for three years and has gained over two stone in weight since treatment.

The cases afford sufficient evidence that any patient with lung abscess may have a foreign body in his lung and that the removal of this will cure him. Therefore bronchoscopic examination appears to be essential, without exception.

Conclusions.—Of twenty-seven patients with lung abscess fifteen have been cured by bronchoscopy. If cases of foreign body are excluded, seven have been cured out of a series of nineteen. Eight have been improved, some to a marked extent. Two were not improved. Two died in spite of, and not as a result of treatment; one had been ill for some years, and the other, an old lady, succumbed to heart failure following the attack of pneumonia which caused the lung abscess.

These observations take into account all cases, however unfavourable. In one bronchoscopic treatment was not begun until twelve years after the onset of his disease. If patients were referred at an early date the results would no doubt be even better.

One hundred and thirty-nine bronchoscopies in all were required for the twenty-seven patients. Observation shows that no prognosis can be made before bronchoscopic examination, nor can the number of treatments necessary in any case be decided beforehand.

Dr. L. S. T. Burrell said that he would refer only to single abscess of the lung following operations on the nose, throat, or teeth.

There were only four methods of dealing with such an abscess: (1) to leave the patient alone; (2) to treat the case by bronchoscopy; (3) to drain surgically; (4) to induce pneumothorax. In the profession as a whole the pendulum swung from one method to the other. Looking through the records of his own cases and others, what impressed him was the seriousness of abscess of the lung and how impossible it was to advocate a single line of treatment for all cases of the condition. If a foreign body was present he agreed that bronchoscopy should be carried out. An abscess which drained freely went on towards cure, and by sucking out the abscess contents one was doing little more than making the connection through the trachea patent. He was appalled at the number of patients who died if treated by simple medical means.

At one time he thought that surgery with drainage was the treatment and that this should be performed early; but when he went through his own cases and read about the cases of other physicians, he was surprised at the proportion of patients who had died or had a recurrence of the condition. Though, in the future, surgery might be the treatment for the condition, up to the present time, in his experience, it had not fulfilled the expectations which were formed in regard to it.

The induction of pneumothorax was also extremely dangerous; it was especially so in cases of superficial abscess, and his experience had been that a great number of these abscesses were superficial.

What, therefore, must be done? He thought the patient in this matter was like a man in a burning house in the attic. If he stayed where he was, the fire might be put out and he be saved; he might try to descend the stairs and risk suffocation; or he might try to jump out of the window, in which event he would probably be killed. The profession should not say that this or that treatment was the correct one for lung abscess. Five or six years ago he had treated an abscess of lung by pneumothorax, and the patient was now well and in a busy medical practice. Last year another patient had come to him (the speaker) on account of lung abscess; he had hesitated to treat him by pneumothorax or to call in a surgeon, and the patient had died. To have left that case untreated weighed as much on his mind as if pneumothorax had been established and rupture into the pleural cavity had occurred. He had been interested to hear Mr. Hunter say that rupture into the pleural cavity was not so serious as it had been made out to be. He (Dr. Burrell) had had cases in which, after pneumothorax, this accident had happened and the patient had recovered. Though he did not advocate pneumothorax treatment for abscess of the lung, it should not be completely discarded. He would ask those who declared pneumothorax to be dangerous to say also "So is surgery, and so is leaving the patient alone." If the lung abscess was superficial he thought surgery was the best and safest treatment, but if it was central and one saw the case early he frankly believed the safest treatment to be collapse of the lung.

Mr. A. Tudor Edwards said that there were two types of symptoms. He thought that all the cases of pulmonary abscess with intermittent discharge from the abscess were diagnosed as such, but there was another type in which the discharge from the abscess was continuous, and this latter type was often confused with bronchiectasis. Unless that fact was borne in mind these cases were missed and later bronchiectasis was established and the chance of adequate treatment of the abscess was lessened or lost.

He differed from both Dr. Burrell and Mr. Hunter concerning effusions. There were two types of effusion secondary to pulmonary abscess. One was the chronic and slowly-forming localizing empyema; he had had nine of these, secondary to a pulmonary abscess; they did extremely well; eight of the patients were still alive and well. But the condition was different when there existed a large pleural cavity in which there were practically no adhesions, i.e., the only ones present were those around the abscess. There was a widespread infection of the pleura and much general reaction. He had had five such cases, in three of which the patients had died. Mr. Hunter had demonstrated two cases of empyema on the screen, and he (the speaker) was convinced that in these there had been slow leaking through the pleura, which had been shut off from the general pleural cavity by adhesions. Those cases had done well.

Another point was that cerebral abscess occurred in connection with undrained lung abscess. He had seen two of these in the last four months. Abscess had developed before surgery was undertaken, and the patients died from the abscess. In two other cases he had operated, but the cerebral abscess had burst in the ventricle within a week. The autopsies in both showed thick-walled chronic abscesses. He could not think that those results were due to surgery; they had originated some time before the operation.

He (the speaker) was increasingly convinced that drainage should always be carried out as a two-stage procedure. On one occasion he had performed rib resection over an abscess, and found what he thought were firm adhesions. The patient had coughed violently—she was under local anæsthesia—and tore away the adhesions after he had begun to incise the lung. General effusion into the pleura occurred,

and the patient died. Had a two-stage procedure been undertaken, she would probably have lived.

The surgeon should remove a sufficient amount of lung tissue over the abscess.

In the second stage he diathermized the lung over the abscess, using a button electrode for coagulation, and removing it with a wire-cutting loop diathermy. That prevented the lodgment of emboli in the circulation—as all the vessels were sealed by the diathermy—and diminished the chances of cerebral abscess.

He preferred packing to drainage for a few days after the operation; it kept the abscess wider open, and drainage could subsequently be carried out by soft tubes.

In a certain number of these cases of abscess, chronic bronchial fistulæ developed, owing to the fact that they were delayed operation cases. When opening some of the long-standing abscesses one found a lining to the abscess which was smooth and almost completely covered by mucosa, similar to that lining the bronchi, and on opening widely, a condition of lattice-lung would be found—a wide-spread communication between the bronchi and the cavity. If operated upon earlier, the cases were much more likely to heal finally and satisfactorily.

In three cases he had performed pneumolysis; in one he could not find the abscess cavity. This was a method to be considered in certain cases, as in all these three it had resulted satisfactorily.

As to phrenic evulsion, that was occasionally useful for basal cases. He had carried it out in three cases, in two of which the result had been satisfactory.

He was not a keen advocate of thoracoplasty for a freely-draining abscess. That operation should be reserved for a later period, rather than performed at an early stage of the condition. At an early stage there was liable to be poured into the basal bronchi, during the operation, a quantity of infective material, causing secondary pneumonia. In three of the cases in which there was this lattice-lung condition he had performed lobectomy, which he considered was the only satisfactory treatment for that condition. Two of the patients were still alive and well; one had died.

He was somewhat prejudiced against pneumothorax treatment, probably because, as a surgeon, he saw the failures of this treatment.

Dr. R. A. Young in reply, said that with regard to Mr. Hunter's remarks about embolic and inhalation abscesses following nose and throat operations, he, the speaker, still thought they were largely, if not almost entirely, due to aspiration. He knew that many of them occurred in the upper lobe, and that from experiments it seemed that embolic factors might be concerned, but there were two things needing a good deal of explanation. One was the extraordinary frequency of this condition in America; the other was that, almost exclusively, these abscesses were in the right lung, and that favoured the aspiration view.

In reply to Dr. Maxwell's remarks, he, Dr. Young, would have said that pneumonic abscesses were much less common than Dr. Maxwell considered them to be and that by far the greater proportion of the abscesses seen were due to post-operative conditions. Statistics showed that 10% were due to malignant disease.

He thought that lung abscess was commoner than Dr. Kerley had suggested.

Mr. Negus' remarks would be of interest to all; it should be generally recognized that the bronchoscope could play a very useful part, especially in cases of lung abscess following the aspiration of a foreign body.

He did not often differ from Dr. Burrell, and even now he was cautious about doing so, but he remained unconvinced by Dr. Burrell's remarks as to artificial pneumothorax; he regarded it as too much of a lottery. He agreed that lung abscess was a very serious condition; but with regard to Dr. Burrell's comparison

to a fire in a house, he, Dr. Young, thought that there had been two means of escape mentioned this evening for the unfortunate people: the fireman with his hose in the shape of bronchoscopy, and the surgeon coming up the ladder with his axe.

He was glad to hear Mr. Tudor Edwards' commendation of pneumolysis. He, the speaker, had not had personal experience of it, but he hoped that pneumolysis would develop into a very valuable operation, both for abscess and other conditions.